CSL ENGINEERING, INC.

JN 772

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

PRELIMINARY HYDROLOGY AND HYDRAULIC CALCULATIONS

FOR

TENTATIVE TRACT 17325

IN

COTO DE CAZA

DATE: 01-11-10

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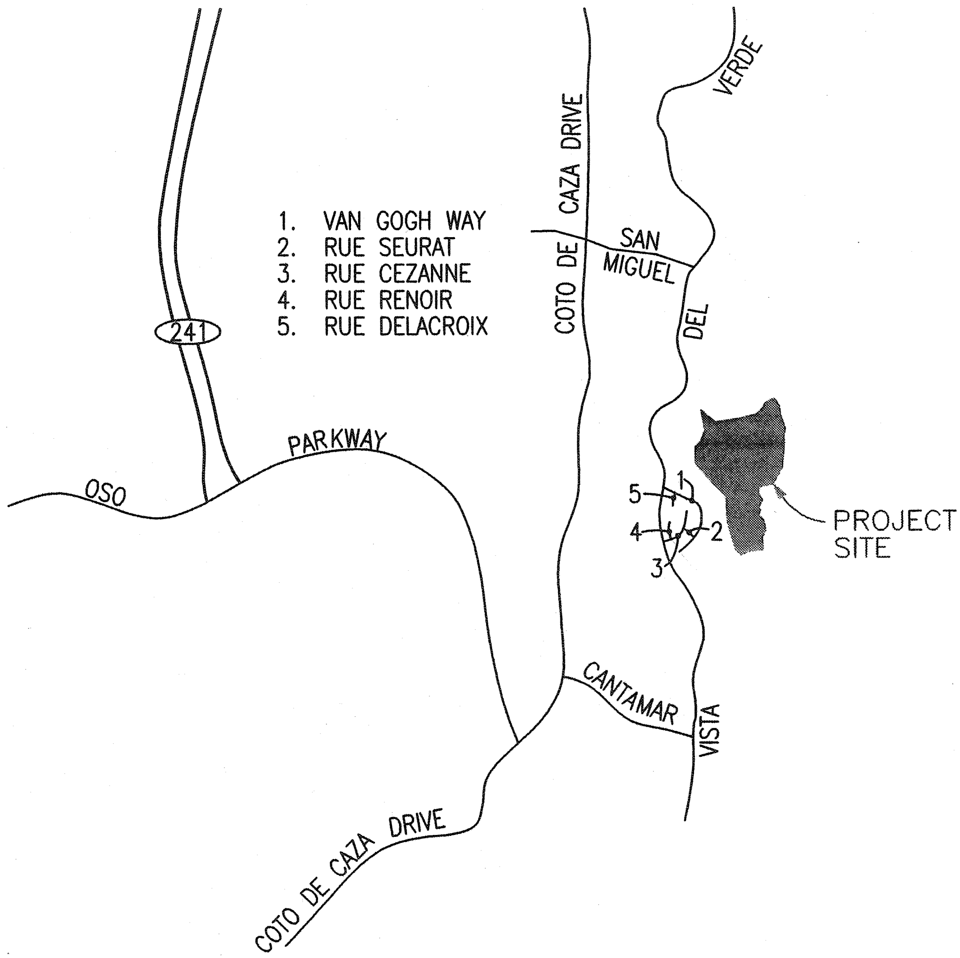
TENTATIVE TRACT 17325



VICINITY MAP

NOT TO SCALE

SECTION 2, TOWNSHIP 7 SOUTH,
RANGE 7 WEST
THOMAS BROS., 2007 ED.,
PG. 923, GRID D-3

INTRODUCTION AND DISCUSSION

Introduction:

This project proposes to develop a 7 lot single-family subdivision located in the County of Orange in the community of Coto De Caza. It is located on a 127 $\pm$ acre site, and is bounded on the west by Tract 15245 (an existing single-family subdivision) and on the east by Open Space owned by the Audubon Society. Approximately 8 $\pm$ acres of the project will be disturbed. The remaining 119 $\pm$ acres will remain as natural open space.

The existing topography of the proposed project consists of rolling hills with several ridges and ravines that direct the flows due west towards Tract 15245. The existing land is undeveloped and largely covered with coastal sage scrub, groupings of coastal live oak trees, chaparral and annual grasses. It is estimated that the land cover is approximately 75% to 90% based upon a visual inspection of the Google Earth images.

Purpose:

The purpose of this study is to present the offsite and onsite hydrology for the 10-year and 100-year storms for both the existing condition and the developed condition. The study shall also show that the 10-year flows are contained within the curb to curb limits and the 100-year flows are contained within the road right-of-way. Since this is a preliminary study it is not intended to delve into BMP calculations. Such analysis is reserved for the WQMP, which should be prepared at a later date subsequent to this preliminary hydrology report.

Methodology:

The hydrology calculations presented in this study are based upon the Orange County Hydrology Manual (dated 1986), and will use the Rational Method provided in Section D of the manual as the method of calculating the various Q's. The hydraulic calculations for street capacities will be based upon the Manning's equation using n=0.015. Any storm drains designated on the map will be sized based upon the Manning's equation using n=0.013.

Assumptions:

1. The Q_{10} flows will be handled within the street section up to the top of curb, while the Q_{100} will be contained within the street section up to the right-of-way line.
2. The storm drains will be sized to convey the 100-year developed condition storm flows.
3. Since the vegetated land cover of the project site appears to be over 75%, it shall be considered as "undeveloped – good cover".
4. No BMP calculations are being prepared for this study since a WQMP should contain these calculations. The WQMP should be prepared at a later date subsequent to this preliminary hydrology report.
5. It is assumed, prior to the preparation of the WQMP that grassy swales can be used to clean the first flush flows.

Existing Condition & Developed Condition Hydrology:

The Existing Condition Hydrology is as follows: Q_{10} = 81.1 cfs Q_{100}=130.0 cfs
(Includes all subareas combined)

The Developed Condition Hydrology is as follows: Q_{10} = 85.6 cfs Q_{100}=136.8 cfs
(Includes all subareas combined)

Executive Summary:

As stated previously, this project is disturbing only 8 ± acres of land, which amounts to about 6% of the entire 127 ± acre site. The 7 single-family lots that are proposed as well as the private streets will maintain the same drainage patterns, and the impervious surfaces will add a minor amount of runoff westerly. The additional runoff amounts to less than 6% of the 10-year and 100-year storm events, which may be considered as insignificant and probably should not have a significant impact on the surrounding properties. It is therefore not anticipated to warrant any mitigation.

The project will be nestled between the woodland and shrub areas, and will be graded in a manner so as not to impede the natural drainage courses of the rolling hills. Catch basins and storm drains are proposed in order to better distribute the runoff to areas so as not to significantly impact the downstream flows.

Although a WQMP has not been prepared for the tentative map processing, this project is anticipated to be designed with water quality features, such as grass swales to clean the runoff from the impervious surfaces. The grass swales will adhere to the Orange County Water Quality Control standards, and will be properly sized and designed at the time of the final engineering processing.

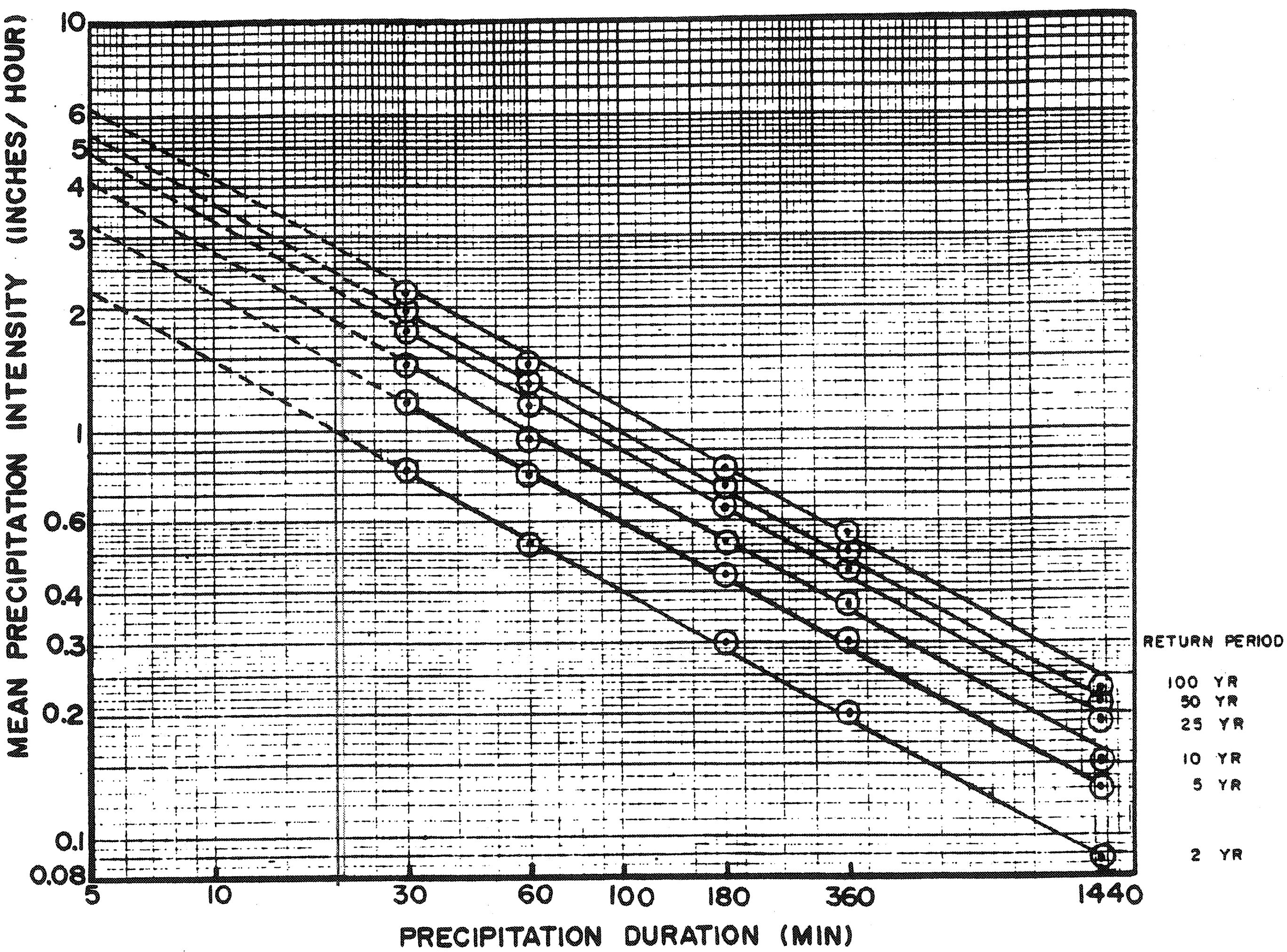
HYDROLOGY

CALCULATIONS

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

(4)

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

Figure B-3

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

ORANGE COUNTY

HYDROLOGY MANUAL

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ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

C.6.4. Estimation of Maximum Loss Rates for Pervious Areas, F_p

Table C.2 lists the maximum loss rates (inch/hour), F_p, for pervious area as a function of soil group.

TABLE C.2.
MAXIMUM EFFECTIVE PERVIOUS AREA LOSS RATES (inch/hour), F_p

SOIL GROUP:	A	B	C	D
F_p:	0.40	0.30	0.25	0.20

USE THIS

Table C.2 reflects the model calibration assuming an F_p of 0.30 in/hr. for all the considered catchments and storm return frequencies. This mean value of F_p of 0.30 in/hr. was assigned to Hydrologic Soil Group B due to the actual average soil conditions in the reconstitution study areas. The F_p values for Hydrologic Soil Groups A, C, and D, were assigned to account for the different soil types that may be found in Orange County.

C.6.5. Estimation of Catchment Maximum Loss Rates, F_m

The maximum loss rate selected from Table C.2 applies to the pervious area fraction of the watershed. The loss rate assumed for an impervious surface is 0.0 inch/hour. The maximum loss rate, F_m, for a catchment is therefore given by

$$F_m = a_p F_p \qquad (C.7)$$

where a_p is the pervious area fraction and F_p is the maximum loss rate for the pervious area (Section C.6.4).

Should a catchment contain several F_m values, the composite F_m value is determined as a simple area average of the several F_m values.

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D.6. PEAK FLOW RATE FORMULA

Combining Equations (D.1) and (D.3), the peak flow estimate for Q is written in simpler terms by

$$Q = .90\,(I - F_m)A \qquad \text{(D.4)}$$

where $F_m = a_pF_p$ (see section C.6.5), and where in (D.4) it is understood that I is greater than F_p; otherwise $Q = .90\,a_iIA$.

In (D.4), F_m represents the loss rate for the total watershed tributary to the point of concentration. Should the tributary area contain several runoff surfaces, an area-averaged F_m is calculated. Table D.1 illustrates such an area-averaged F_m computation.

TABLE D.1. AREA-AVERAGED F_m COMPUTATION

Subarea Number (1)	a_p (2)	Soil Group (3)	F_p (inch/hour) (4)	Area (acres) (5)	Area Weighting of (4)
1	0.60	A	0.40	8	1.92
2	0.80	B	0.30	12	2.88
3	0.75	C	0.25	11	2.06
4	0.10	D	0.20	15	0.30
5	0.50	C	0.25	16	2.00
				62	9.16

From Table D.1., the area-averaged maximum loss rate, F_m, is given by F_m = (9.16)/(62) = 0.147 inch/hour, say 0.15.

D.7. DRAINAGE AREA

The contributing drainage area may be determined from topographic contour maps, aerial photos, and field surveys. Watershed divides are then drawn on a suitable topographic map and the enclosed drainage area is determined by planimeter or other methods. In areas where lateral and transverse slopes on the watershed are very mild, the nominal watershed area (or drainage subdivision) runoff may "cascade" under severe rainfall. That is, when the divide between one watershed and another is defined by a low relief feature such as the crown of a road, the runoff from such a watershed may "spill over" into the adjacent watershed or watershed subdivision. This may occur, for example, when gutter capacity is exceeded thereby increasing runoff contributions at downstream or adjacent concentration points above those anticipated by analysis of the nominal or "low flow" drainage boundaries. The possibility of such cascading shall be considered and provided for by the hydrologist.

D.8. RATIONAL METHOD CONFLUENCE ANALYSIS

In most studies, the calculation of peak flow rates along a main channel or stream involves only the direct application of (D.4). Such studies typically involve the inclusion of subarea runoff to the stream where the effect on the stream peak flow rate is relatively minor and, consequently, only (D.4) is needed for the analysis.

At the junction of two or more streams, however, the estimation of the peak flow rate involves a confluence analysis of the associated runoff hydrographs (see Appendix III).

For the confluence of two streams, let T_1, I_1, Fm_1, A_1, and Q_1, be the time of concentration, rainfall intensity, area-averaged loss rate, catchment area, and peak flow rate for stream #1 while T_2, I_2, Fm_2, A_2 and Q_2 correspond to stream #2. Also, let Q_1 be less than Q_2. Finally, let T_p, A_p, and Q_p be the resulting confluence estimates for Tc, area, and peak flow rate, respectively. Then two cases are possible:

*Case <u>1</u>: $T_1 = T_2$. The runoff hydrographs must both peak at $T_p = T_1 = T_2$. And $Q_p = Q_1+Q_2$ for a total contributing area of $A_p = A_1+A_2$.

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*Case 2:	$T_1 \neq T_2$. In this case, the sum of the two runoff hydrographs must be considered. Except in very unusual conditions, flow rates of the summed runoff hydrograph typically achieve a maximum at either T_1 or T_2, and the peak flow rate estimates are calculated as follows:
Case 2a:	T_1 is less than T_2. In this case, the stream with the largest Q has the longest Tc. The flow rate of the summed runoff hydrograph at time T_2 is estimated by

$$Q_p = Q_2 + \frac{(I_2 - Fm_1)}{(I_1 - Fm_1)} Q_1 \qquad \text{(D.5)}$$

and $T_p = T_2$ (see Figure D-2). It is noted that the confluence peak Q of (D.5) equals the peak flow rate estimated from direct use of (D.4). Additionally, the total contributing area is $A_p = A_1 + A_2$.

Case 2b: T_1 is greater than T_2. In this case, the stream with the largest Q has the shortest Tc. The flow rate of the summed runoff hydrograph at time T_1 is estimated using a ratio of stream 1 effective rainfall intensities and Tc values corresponding to times T_2 and T_1 giving

$$Q_p = Q_2 + \frac{(I_2 - F_{m_1})}{(I_1 - F_{m_1})} \frac{(T_2)}{(T_1)} Q_1 \qquad \text{(D.6)}$$

and $T_p = T_2$. Equation (D.6) indicates that the peak flow rate at time T_2 is the result of the high peak discharge from stream 2 and the runoff contribution from a fraction of the stream 1 catchment area.

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That is, a portion of the catchment tributary to stream 1 is not contributing at time T_2 and, in the general case, only $(T_2/T_1)A_1$ of the stream 1 catchment area is contributing to the peak flow rate (at time T_2). Consequently for downstream study purposes, the "effective" catchment area corresponding to the subject peak flow rate is

$$A_p = A_2+(T_2/T_1)A_1 \qquad \text{(D.7)}$$

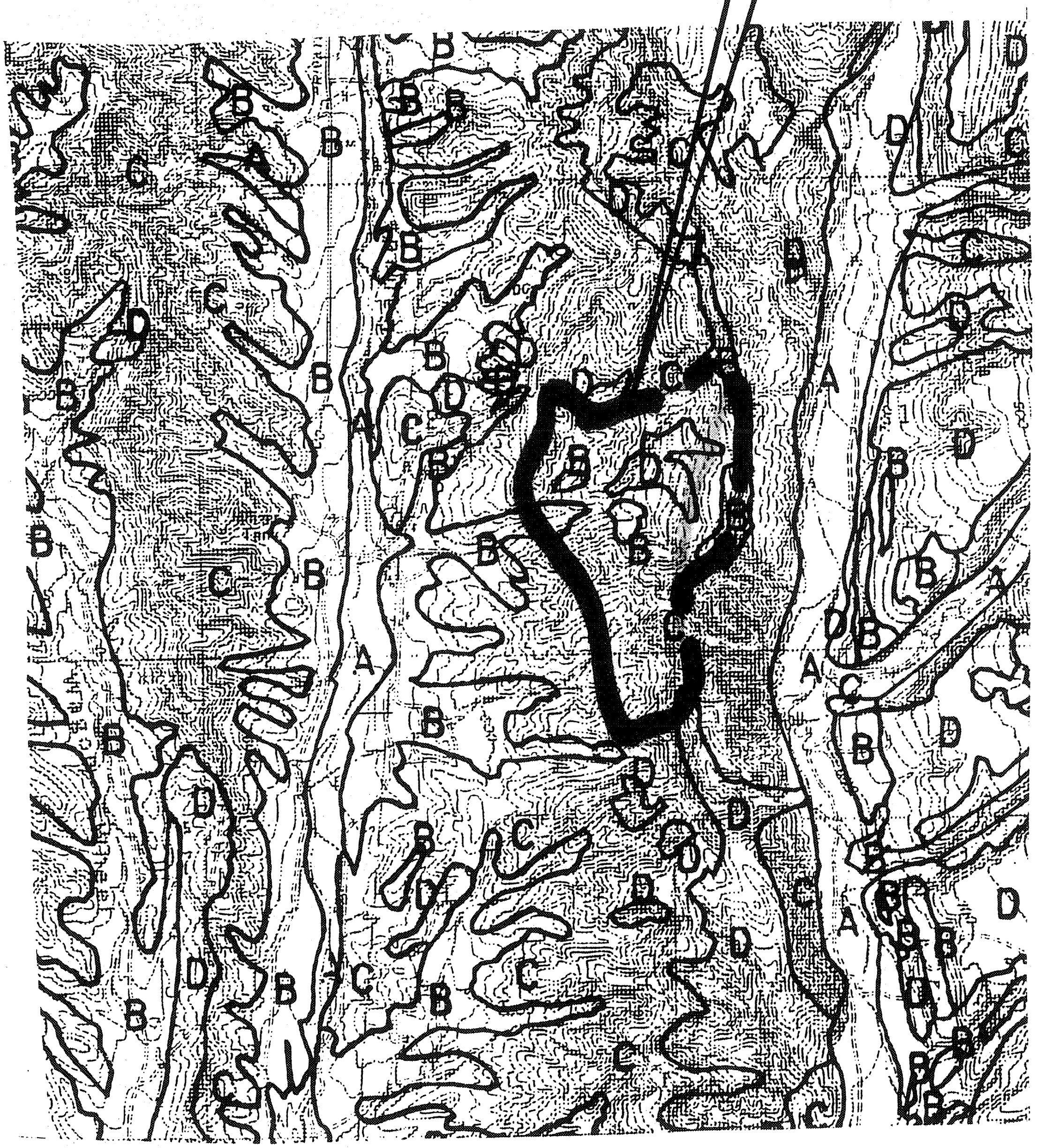
It is noted that in the confluence peak flow rate estimate of (D.6), the critical duration is $T_p = T_2$ which corresponds to the effective catchment area of (D.7) Consequently, the peak flow rate contribution from the effective catchment area of stream 1 must reflect the higher rainfall intensity corresponding to time T_2 rather than time T_1. Use of (D.6) results in a peak flow which equals the governing rational method peak flow rate estimate from (D.4) applied to the effective catchment area computed by (D.7). It is noted that the estimation of the effective catchment area is only an approximation, and shall be verified by the hydrologist.

D.9. RATIONAL METHOD Tc CALCULATIONS FOR UNIT HYDROGRAPH STUDIES

Although the peak flow rate formula should generally not be used for catchments larger than 1 square mile, the rational method can be used to estimate Tc values for larger areas. That is, the rational method estimate for Tc in large areas is adequate for use in the unit hydrograph studies of section E. T-year storm estimates for Tc are determined for areas less than 1 square mile using the T-year intensity-duration curves and the appropriate Fm values to generate cfs/acre estimates. For larger areas, cfs/acre estimates for use in the rational method are obtained from the cfs/acre curves of section L.

PROJECT SITE

NOTE: DUE TO THE AVERAGE MIXTURE OF "B" AND "D" SOIL GROUP AREAS IT WILL BE ASSUMED THAT ALL SUBAREAS CAN USE SOIL GROUP "C".



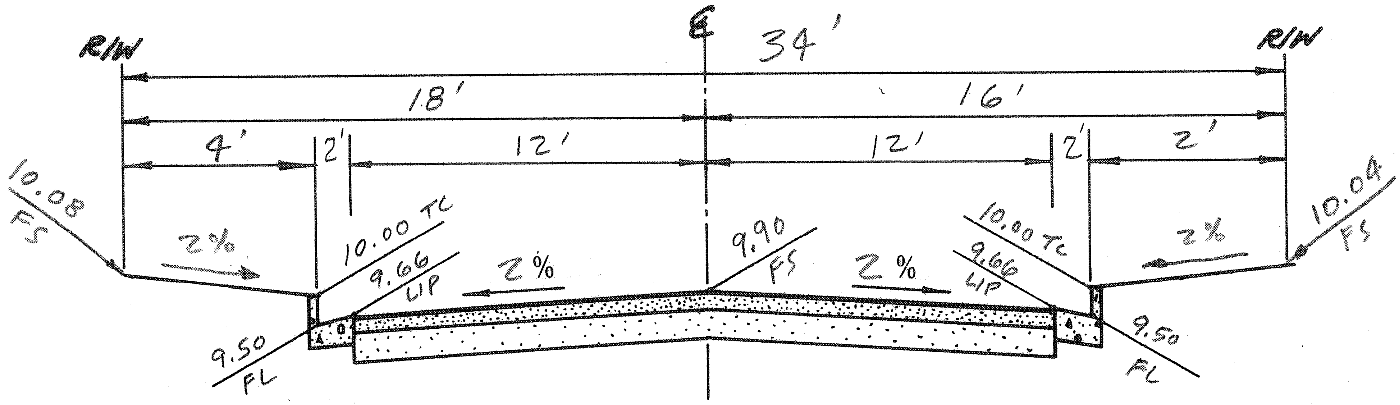
N

SCALE: 1" = 2000'

ENLARGEMENT OF SOILS CLASSIFICATION MAP

PLATE C

MAY 1986 DATE



TYPICAL PRIVATE STREET

N.T.S.

(1) TO T.C. FULL STREET

$A = 6.96$ FT.^{2} $P = 29.00$ FT. ($r = .240$) $n = 0.015$

$K = \frac{1.486}{n} AR^{2/3} = 266.28$

(2) TO CROWN (½) STREET

$A = 2.08$ FT.^{2} $P = 14.40$ FT. ($r = .144$) $n = 0.015$

$K = 56.73$

(3) TO R/W FULL STREET

$A = 8.16$ FT.^{2} $P = 33.00$ FT. ($r = .247$) $n = 0.015$

$K = 318.47$

$Q = KS^{1/2}$

	K	S= 0.005	S= 0.010	S= 0.040	S= 0.080	S=	S=
(1)	266.28	18.8	26.6	53.3	75.3		
(2)	56.73	4.0	5.7	11.3	16.0		
(3)	318.28	22.5	31.8	63.7	90.0		

COMPARISON OF Q's

CONCEN. POINT NODE	EXIST. Q_{10}	COND. AREA	DEVEL. Q_{10}	COND. AREA	EXIST. Q_{100}	COND. AREA	DEVEL. Q_{100}	COND. AREA
20	26.6	19.2	29.9	21.2	42.9	19.2	47.8	21.2
40	22.9	14.7	24.9	13.9	36.6	14.7	39.7	13.9
50	16.5	11.4	16.3	11.0	26.5	11.4	25.5	10.8
65	1.8	0.7	1.9	0.7	2.8	0.7	3.0	0.7
70	5.6	2.5	6.5	3.9	8.8	2.5	11.1	4.1
80	7.7	4.7	6.1	3.8	12.4	4.7	9.7	3.8
TOTALS:	81.1	53.2	85.6	54.5	130.0	53.2	136.8	54.5

EXISTING CONDITON HYDROLOGY

RATIONAL METHOD STUDY FORM EXISTING CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 10 -YEAR STORM RATIONAL METHOD STUDY	Calculated by NRC Date 08-04-09 Checked by RAS Date 12-15-09 Page 1 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q2) 10	8.1	8.1	C	NAT.	—	20.0	1.83	0.25	0.25	11.5	945	0.2021	—	INITIAL SUBAREA
(Q1) 10	5.6	5.6	C	NAT.	—	19.5	1.86	0.25	0.25	8.1	195	0.1610	—	INITIAL SUBAREA
$T_2 > T_1$ } Q_P	$= Q_2 +$	$\left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right) \cdot Q_1$				$A_P =$	$A_1 +$	A_2	$T_P = T_2$					CONFLUENCE ANALYSIS FOR PT #10
USE CASE 2A) Q_P	$= 11.5 +$	$\left(\frac{1.83-0.25}{1.86-0.25}\right) \cdot 8.1$				$A_P =$	5.6+	8.1	$T_P = 20.0$					CONFLUENCE RESULTS
Q_P	= 19.5					$A_P =$	13.7							
10		13.7				20.0				19.5				STREAM SUMMARY
20	5.5	19.2	C	NAT.	0.9	20.9	1.79	0.25	0.25	26.6	415	0.0747	7.6	NATURAL STREAM b=1.0' z=4 n=0.030 D=0.76'

Figure D-4

RATIONAL METHOD STUDY FORM EXISTING CONDITION

ORANGE COUNTY
HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA

10 -YEAR STORM RATIONAL METHOD STUDY

Calculated by NRC Date 08-04-09
Checked by RAS Date 12-15-09
Page 2 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_1) 30	4.6	4.6	C	NAT	—	20.8	1.79	0.25	0.25	6.4	905	0.1525	—	INITIAL SUBAREA
(Q_2) 30	4.9	4.9	C	NAT	—	17.0	2.01	0.25	0.25	7.8	695	0.2475	—	INITIAL SUBAREA
$T_2 < T_1$ Q_P	$= Q_2 +$	$\left(\frac{I_2 - Fm_1}{I_1 - Fm_2}\right)$	$\left(\frac{T_2}{T_1}\right) Q_1$			$A_P =$	$A_1 +$	A_2	$T_P = T_2$					CONFLUENCE ANALYSIS FOR PT # 30
USE CASE 2B Q_P	$= 7.8 +$	$\left(\frac{2.01-0.25}{1.79-0.25}\right)$	$\left(\frac{17.0}{20.8}\right) 6.4$			$A_P =$	4.6+	4.9	$T_P = 17.0$					
Q_P	$= 13.8$					$A_P =$	9.5							
30		9.5				17.0				13.8				STREAM SUMMERY
40	5.2	14.7	C	NAT	0.5	17.5	1.98	0.25	0.25	22.9	260	0.1000	8.0	NATURAL STREAM b=1.0' z=4 n=0.030 D=0.63

RATIONAL METHOD STUDY FORM

EXISTING CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 10 -YEAR STORM RATIONAL METHOD STUDY	Calculated by NRC Date 08/05/09 Checked by RAS Date 12/16/09 Page 3 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 50	8.0	8.0	C	NAT.	—	19.5	1.86	0.25	0.25	11.6	915	0.2098	—	INITIAL SUBAREA
(Q_1) 50	3.4	3.4	C	NAT.	—	18.8	1.90	0.25	0.25	5.0	770	0.1818	—	INITIAL SUBAREA
$T_2 > T_1$ Q_P	$= Q_2 +$	$\left(\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right)$	Q_1			A_P	$= A_1 +$	A_2	T_P	$= T_2$				CONFLUENCE ANALYSIS FOR PT. # 50
USE CASE 2A Q_P	$= 11.6 +$	$\left(\frac{1.86 - 0.25}{1.90 - 0.25}\right)$	5.0			A_P	$= 3.4$	$+ 8.0$	T_P	$= 19.5$				CONFLUENCE RESULTS
Q_P	$= 16.5$					A_P	$= 11.4$							
50		11.4				19.5				16.5				STREAM SUMMARY
65	0.7	0.7	C	NAT	—	8.2	3.06	0.21	0.21	1.8	478	0.1925	—	INITIAL SUBAREA
65		0.7								1.8				STREAM SUMMARY
70	2.5	2.5	C	NAT	—	10.0	2.73	0.24	0.24	5.6	655	0.1496	—	INITIAL SUBAREA
70		2.5				10.0				5.6				STREAM SUMMARY
80	4.7	4.7	C	NAT	—	16.0	2.08	0.25	0.25	7.7	550	0.2036	—	INITIAL SUB AREA
80		4.7				16.0				7.7				STREAM SUMMARY

Figure D-4

RATIONAL METHOD STUDY FORM

EXISTING CONDITION

ORANGE COUNTY
HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA

100 -YEAR STORM RATIONAL METHOD STUDY

Calculated by NRC Date 08/04/09
Checked by RAS Date 12-16-09
Page 1 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 10	8.1	8.1	C	NAT	—	20.0	2.80	0.25	0.25	18.6	945	0.2021	—	INITIAL SUBAREA
(Q_1) 10	5.6	5.6	C	NAT	—	19.5	2.84	0.25	0.25	13.1	195	0.1610	—	INITIAL SUBAREA
$T_2 > T_1$ } Q_P	$= Q_2 +$	$\left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right)$	$\cdot Q_1$			$A_P =$	$A_1 +$	A_2	$T_P = T_2$					CONFLUENCE ANALYSIS FOR PT #10
USE CASE 2A } Q_P	$= 18.6 +$	$\left(\frac{2.8 - 0.25}{2.84 - 0.25}\right)$	$\cdot 13.1$			$A_P =$	$5.6 +$	8.1	$T_P = 20.0$					
Q_P	$= 31.5$					$A_P =$	13.7							
10		13.7				20.0				31.5				STREAM SUMMERY
20	5.5	19.2	C	NAT	0.8	20.8	2.73	0.25	0.25	42.9	415	0.0747	8.4	NATURAL STREAM b=2.0' z=4 n=0.030 D=0.84'

RATIONAL METHOD STUDY FORM EXISTING CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 100 -YEAR STORM RATIONAL METHOD STUDY	Calculated by NRC Date 08/05/09 Checked by RAS Date 12-16-09 Page 2 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_1) 30	4.6	4.6	C	NAT	—	20.8	2.73	0.25	0.25	10.3	905	0.1525	—	INITIAL SUBAREA
(Q_2) 30	4.9	4.9	C	NAT	—	17.0	3.07	0.25	0.25	12.4	695	0.2475	—	INITIAL SUBAREA
$T_2 < T_1$ Q_P	$= Q_2 +$	$\left(\frac{I_2 - Fm_1}{I_1 - Fm_1}\right)$	$\left(\frac{T_2}{T_1}\right) Q_1$			$A_P =$	$A_1 +$	A_2	$T_P = T_2$					CONFLUENCE ANALYSIS FOR PT #30
USE CASE 2B Q_P	$= 12.4 +$	$\left(\frac{3.07-0.25}{2.73-0.25}\right)$	$\left(\frac{17.0}{20.8}\right) \cdot$	10.3		$A_P =$	4.6+	4.9	$T_P = 17.0$					
Q_P	$= 22.0$					$A_P =$	9.5							
30		9.5				17.0				22.0				STREAM SUMMERY
40	5.2	14.7	C	NAT	0.5	17.5	3.02	0.25	0.25	36.6	260	0.1000	9.0	NATURAL STREAM $b = 1.0'$ $z = 4$ $n = 0.030$ $D = 0.77'$

Figure D-4

RATIONAL METHOD STUDY FORM   EXISTING CONDITION

ORANGE COUNTY HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA

100 -YEAR STORM RATIONAL METHOD STUDY

Calculated by NRC Date 08/05/09

Checked by RAS Date 12-16-09

Page 3 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 50	8.0	8.0	C	NAT	—	19.5	2.84	0.25	0.25	18.6	915	0.2098	—	INITIAL SUBAREA
(Q_1) 50	3.4	3.4	C	NAT	—	18.8	2.90	0.25	0.25	8.1	770	0.1818	—	INITIAL SUBAREA
$T_2 > T_1$ }	$Q_p = Q_2 +$	$\left(\frac{I_2 - F_{m_1}}{I_1 - F_{m_1}}\right) Q_1$				$A_p =$	$A_1 + A_2$		T_p	$= T_2$				CONFLUENCE ANALYSIS FOR PT. # 50
USE CASE 2A	$Q_p = 18.6 +$	$\left(\frac{2.84 - 0.25}{2.90 - 0.25}\right) 8.1$				$A_p =$	3.4 +	8.0	T_p	= 19.5				
						$A_p =$	11.4							
Q_p	= 26.5													CONFLUENCE RESULTS
50		11.4				19.5				26.5				STREAM SUMMARY
65	0.7	0.7	C	NAT	—	8.2	4.66	0.21	0.21	2.8	478	0.1925	—	INITIAL SUBAREA
65		0.7				8.2				2.8				STREAM SUMMARY
70	2.5	2.5	C	NAT	—	10.0	4.16	0.24	0.24	8.8	655	0.1496	—	INITIAL SUBAREA
70		2.5				10.0				8.8				STREAM SUMMARY
80	4.7	4.7	C	NAT	—	16.0	3.18	0.25	0.25	12.4	550	0.2036	—	INITIAL SUBAREA
80		4.7				16.0								STREAM SUMMARY

Figure D-4

(EXISTING CONDITION)

BACK-UP

CALCULATIONS

F_M LOSS RATE CALCULATIONS FOR EXISTING CONDITION AREAS

NODES 60 TO 65

IMPERVIOUS AREAS:

STREET : 20' x 175' = 3,500 SF

CONC. GUTTER : 3' x 340' = 1,020 SF

TOTAL = 4,520 SF

= 0.10 ACRES

TOTAL AREA = 0.70 ACRES

PERVIOUS AREA = 0.70 − 0.10 = 0.60 ACRES

$\therefore \quad a_p = \frac{0.60}{0.70} = 0.857$

PER TABLE C.2 FOR SOIL "C" $F_p = 0.25$

$F_M = a_p F_p = (0.857)(0.25) = \underline{0.21}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 60 TO 70

IMPERVIOUS AREA:

STREET: 20' × 275' = 5,500 SF

CONC. GUTTER: 3' × 195' = 585 SF

TOTAL = 6,085 SF

= 0.14 ACRES

TOTAL AREA = 2.50 ACRES

PERVIOUS AREA = 2.50 − 0.14 = 2.36 ACRES

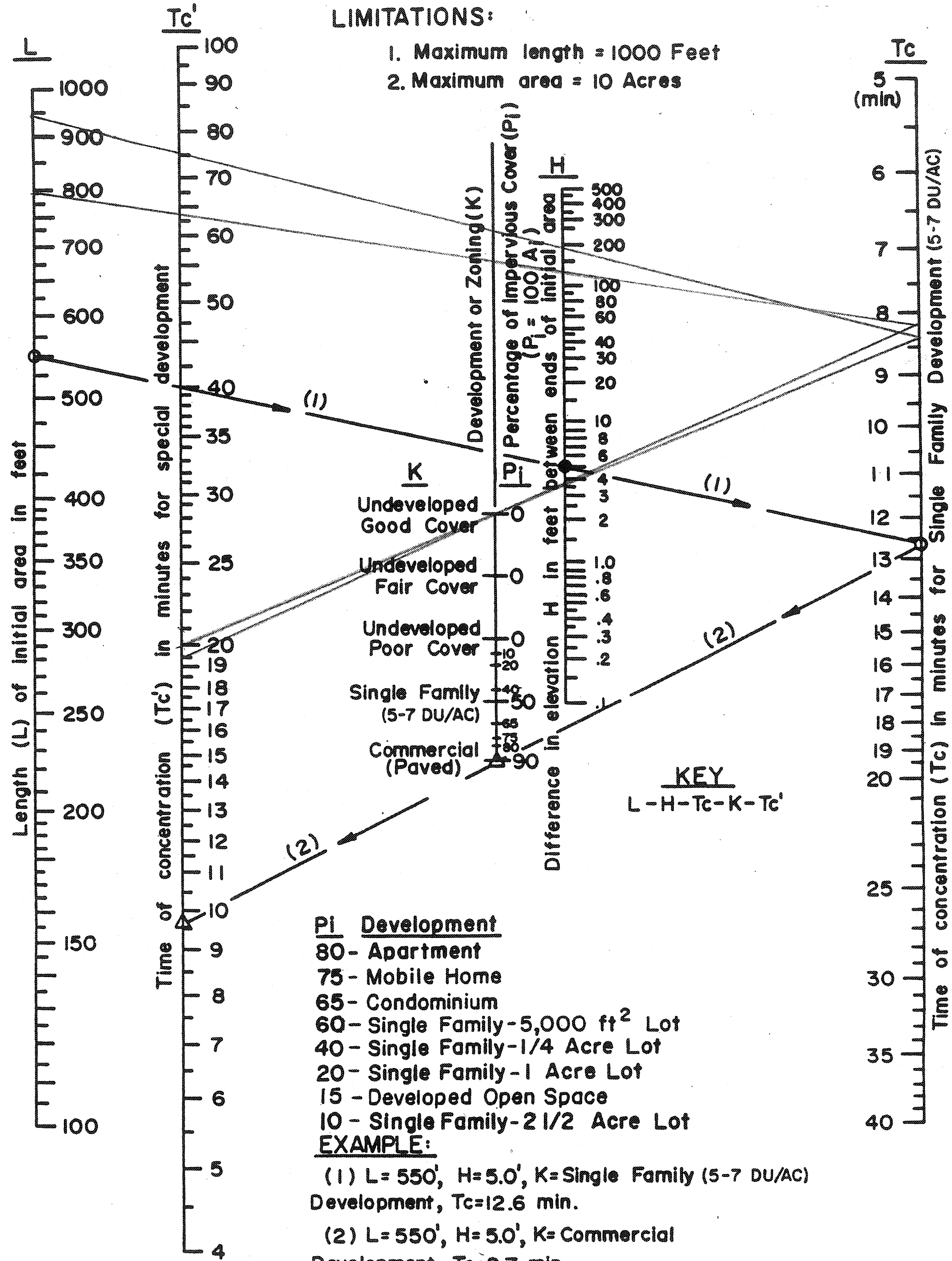
$\therefore\ a_p = \frac{2.36}{2.50} = 0.944$

PER TABLE C.2 FOR SOIL "C" $F_p = 0.25$

$F_m = a_p F_p = (0.944)(0.25) = \underline{0.24}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

#10 EXIST. COND.



LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres

Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family-5,000 ft^2 Lot
40	Single Family-1/4 Acre Lot
20	Single Family-1 Acre Lot
15	Developed Open Space
10	Single Family-2 1/2 Acre Lot

EXAMPLE:

(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.

(2) L= 550', H= 5.0', K= Commercial Development, Tc= 9.7 min.

ORANGE COUNTY
HYDROLOGY MANUAL

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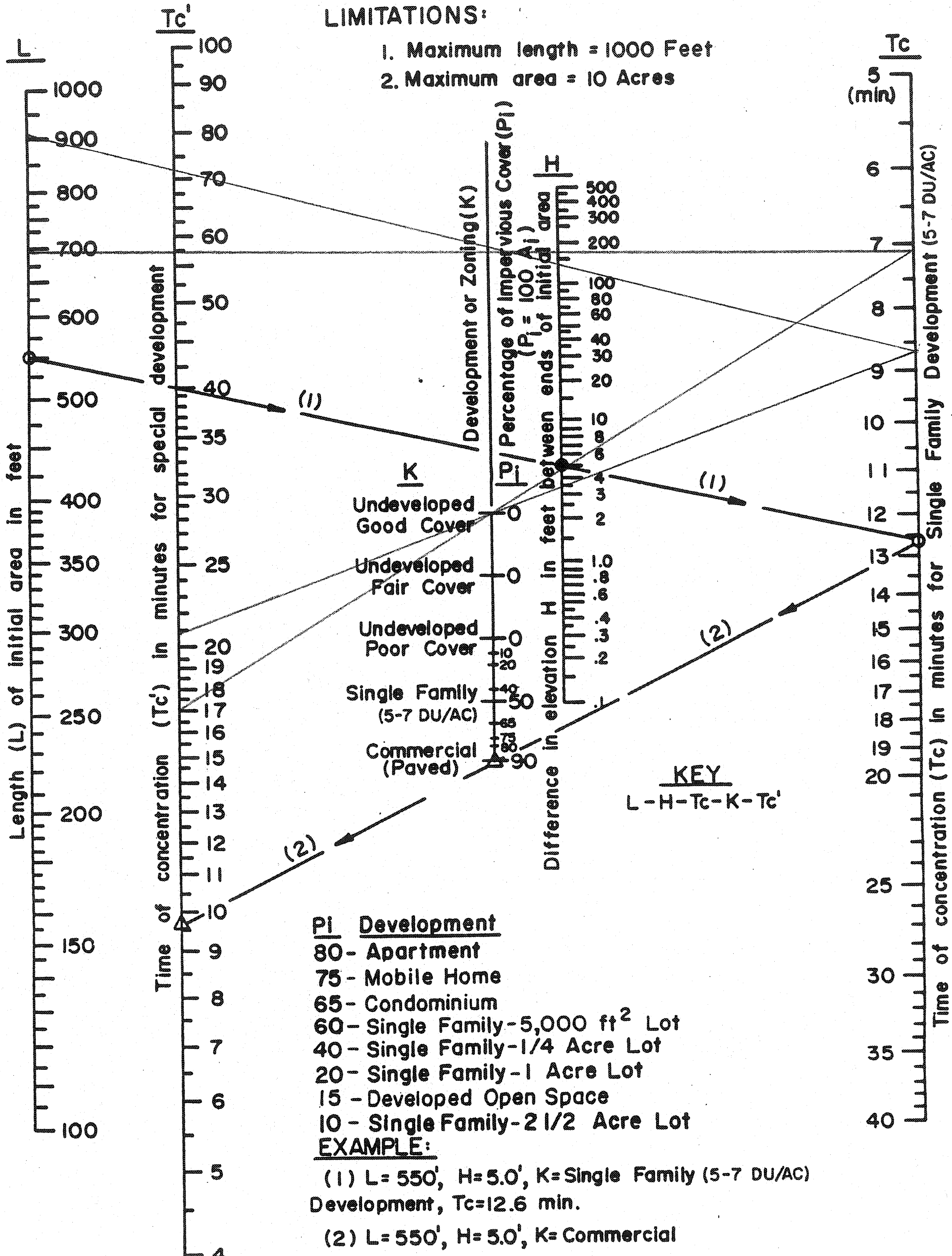
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#30 EXIST. COND.

LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres



Pi Development

80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft^2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot

EXAMPLE:

(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.

(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.

ORANGE COUNTY
HYDROLOGY MANUAL

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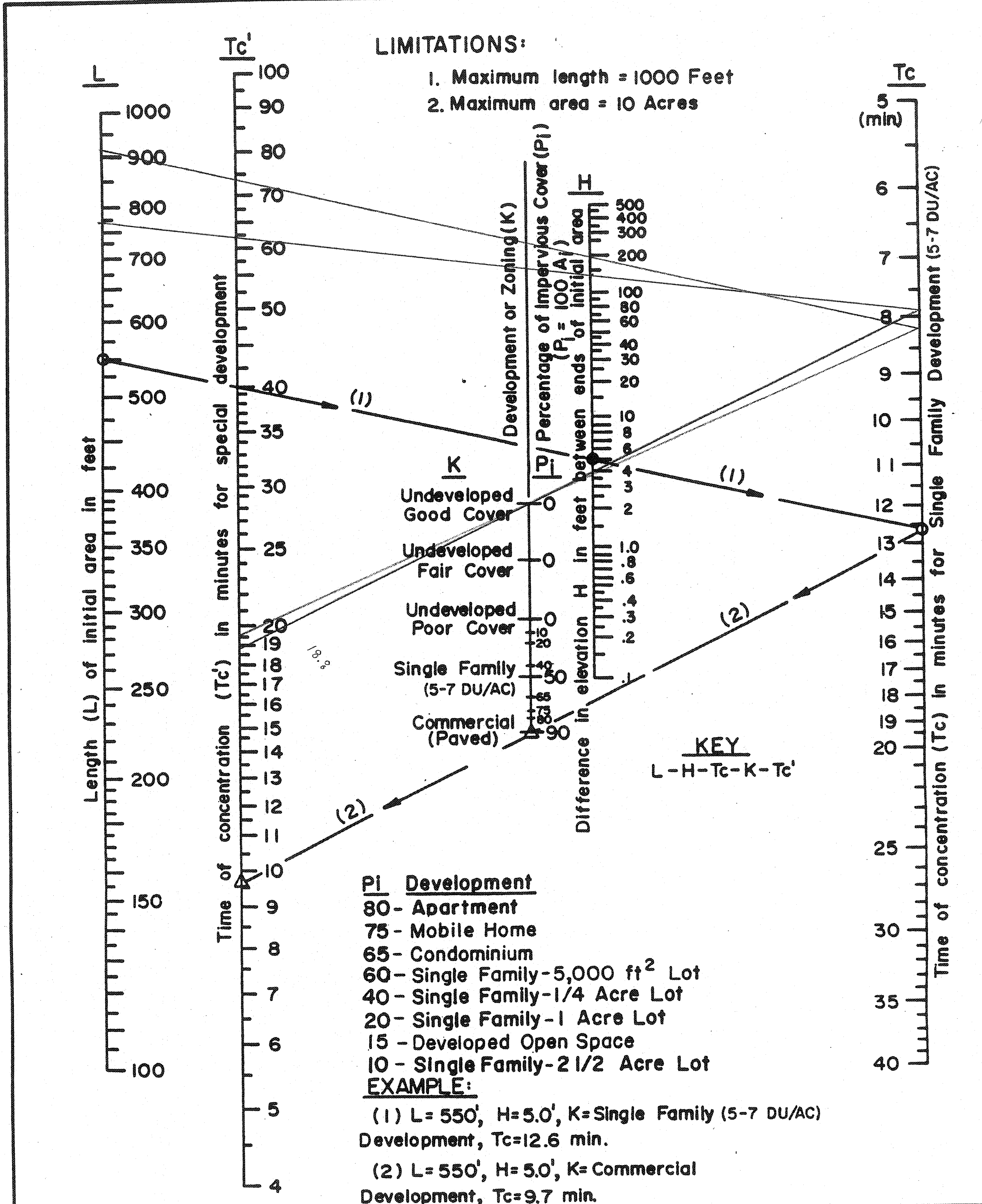
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#50 EXIST. COND.



ORANGE COUNTY
HYDROLOGY MANUAL

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TIME OF CONCENTRATION
NOMOGRAPH
FOR INITIAL SUBAREA

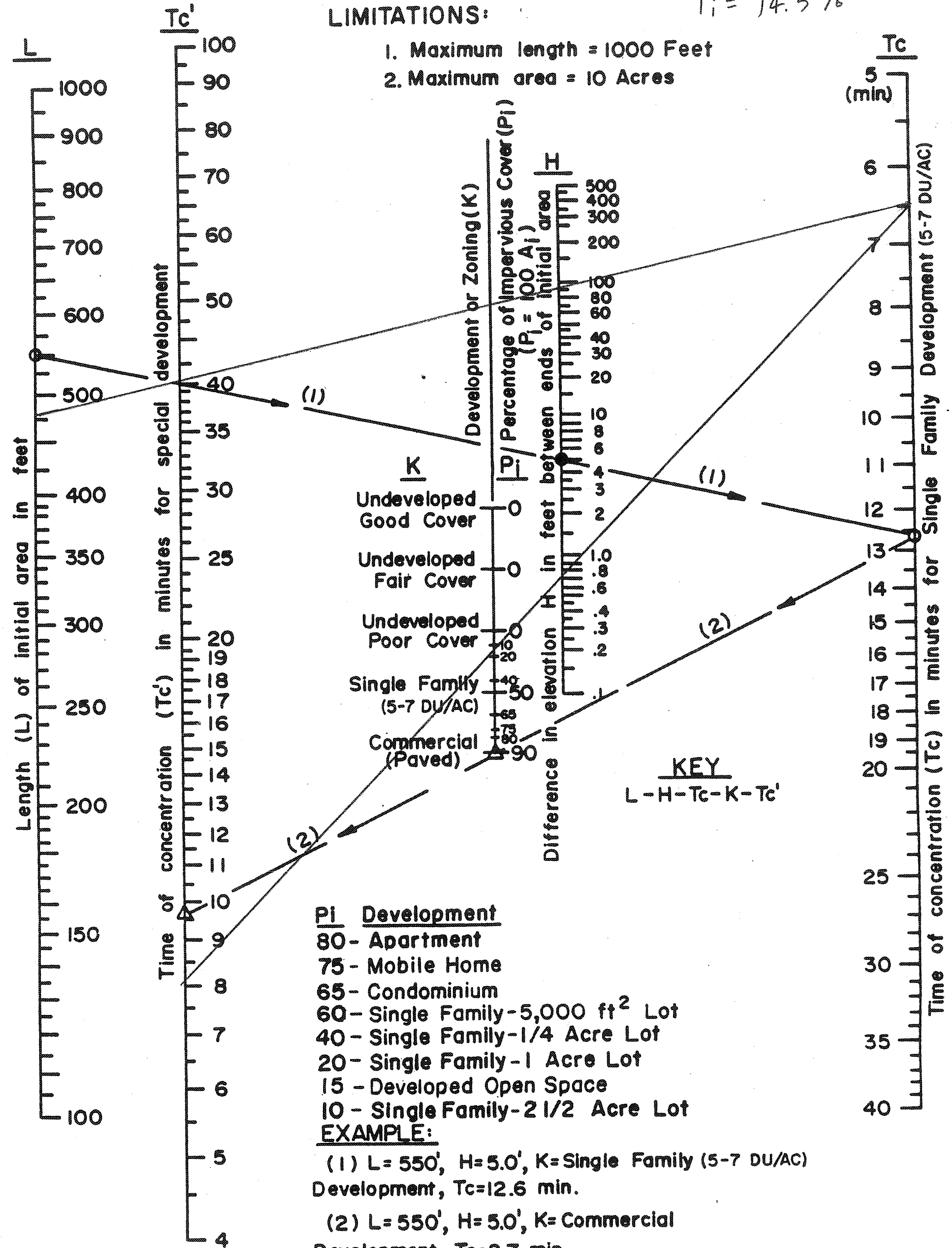
Figure D-1

#65 EXIST. COND.

$P_i = 14.3\%$

LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres



Pi Development

80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family-5,000 ft^2 Lot
40 - Single Family-1/4 Acre Lot
20 - Single Family-1 Acre Lot
15 - Developed Open Space
10 - Single Family-2 1/2 Acre Lot

EXAMPLE:

(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.

(2) L= 550', H= 5.0', K= Commercial Development, Tc= 9.7 min.

ORANGE COUNTY

HYDROLOGY MANUAL

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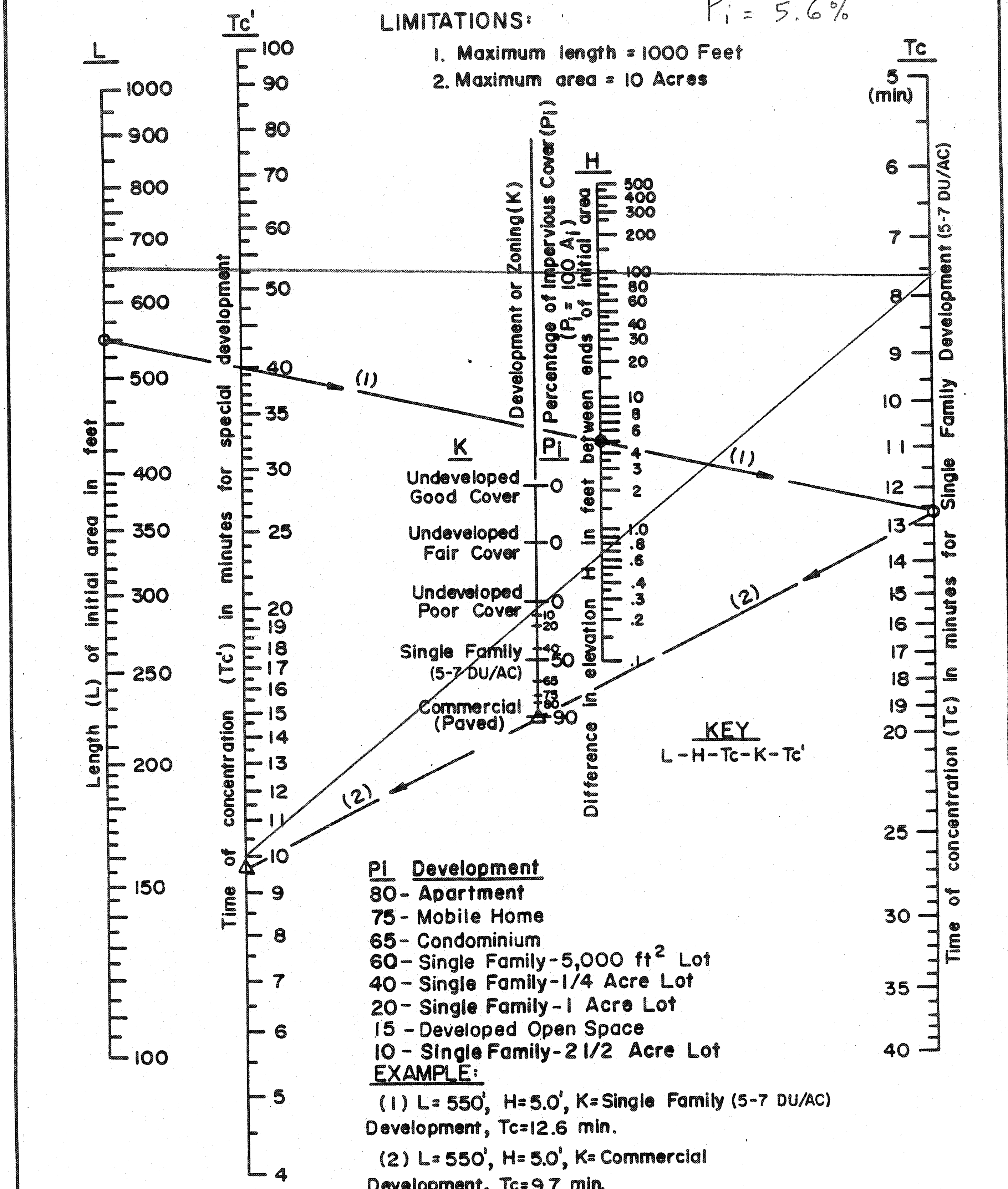
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#70 EXIST. COND.

$P_i = 5.6\%$



ORANGE COUNTY

HYDROLOGY MANUAL

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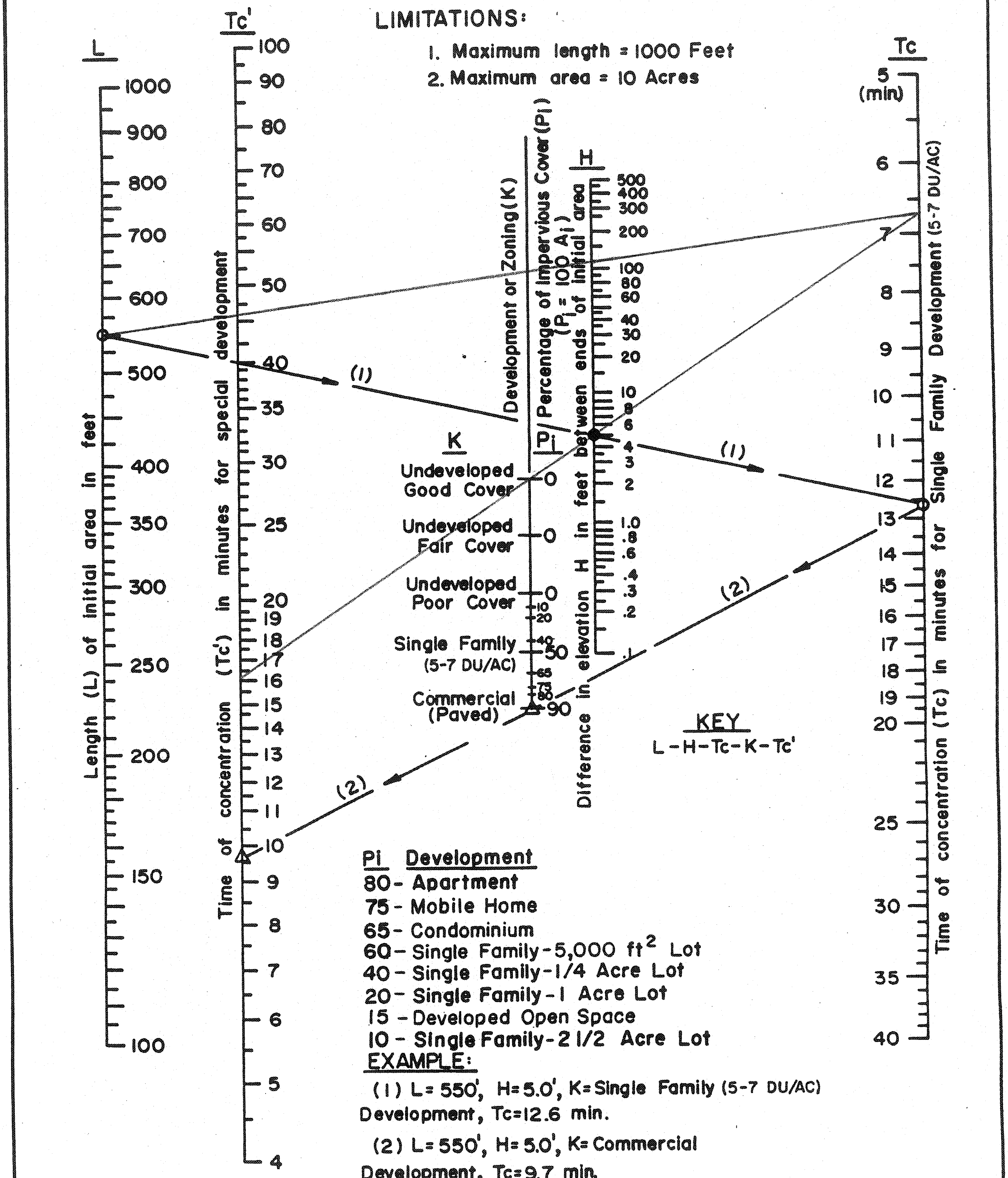
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

\# 80 EXIST. COND.



ORANGE COUNTY

HYDROLOGY MANUAL

(27)

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#10 INTENSITY & Q FOR 10-Y

$I_{(t)} = at^b$

$I = 10.209(20)^{-0.573}$

$I = 1.8344$

$I = 10.209(19.5)^{-0.573}$

$I = 1.8612$

$Q = 0.90(I - F_m)A$

$Q = 0.90(1.83 - 0.25)(8.1)$

$Q = 11.5$

$Q = 0.90(1.86 - 0.25)(5.6)$

$Q = 8.1$

CONFLUENCE

CASE 2A @ #10 FOR 10-Y

$T_1 < T_2$ USE CASE 2A

$T_2 = 20.0$	$T_1 = 19.5$
$I_2 = 1.83$	$I_1 = 1.86$
$F_{m2} = 0.25$	$F_{m1} = 0.25$
$A_2 = 8.1$	$A_1 = 5.6$
$Q_2 = 11.5$	$Q_1 = 8.1$

$$Q_P = Q_2 + \left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right) Q_1$$

$$Q_P = 11.5 + \left(\frac{1.83 - 0.25}{1.86 - 0.25}\right)(8.1)$$

$Q_P = 19.5$

10-Y

#20 VELOCITY & DEPTH OF FLOW

$11.5/8.1 = 1.42$ $8.1/5.6 = 1.45$

AVE CFS/ACRE = 1.43

$$\frac{1.43 \times 5.5}{2} = 3.9$$

$Q_P = 19.5$

$19.5 + 3.9 = 23.4$

AVERAGE SLOPE = 0.0747

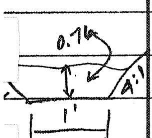
$Q = K'/n\, b^{8/3} s^{1/2}$

$Q = 23.4,\ n = 0.030,\ b = 1,\ s = 0.0747$

$$\frac{Qn}{b^{8/3} s^{1/2}} = K'$$

$$K' = \frac{23.4(0.030)}{(1)^{8/3}(0.0747)^{1/2}} = 2.5685$$

$2.57 \Rightarrow 0.76\ D/b$



$D/b = 0.76 \Rightarrow D = 0.76'$

$A = 0.76 + 2.31 = 3.07$

$V = Q/A = 23.4/3.07 = 7.62$ Ft/s

#20 T_t VALUE 10-Y

$T_t = L/(V)(60)$

$V = 7.6,\ L = 415$

$$T_t = \frac{415'}{7.6(60)} = 0.91$$

#20 INTENSITY & Q

$I = at^b$ $a = 10.209,\ b = -0.573$

$I = 10.209(20.9)^{-0.573}$

$I = 1.79$

$Q = 0.90(I - F_m)A$

$I = 1.79,\ F_m = 0.25,\ A = 19.2$

$Q = 0.90(1.79 - 0.25)(19.2)$

$Q = 26.6$

#30 INTENSITY & Q FOR 10-Y

$I = at^b$

$a = 10.209$, $b = -0.573$

$I_1 = 10.209(20.8)^{-0.573}$

$I_1 = 1.79$

$I_2 = 10.209(17.0)^{-0.573}$

$I_2 = 2.01$

$Q = 0.90(I - F_m)A$

$Q_1 = 0.90(1.79 - 0.25)\cdot 4.6$

$Q_1 = 6.4$

$Q_2 = 0.90(2.01 - 0.25)\cdot 4.9$

$Q_2 = 7.8$

CONFLUENCE CALC

CASE 2B @ #30 FOR 10-Y

WHERE $T_1 > T_2$ STREAM W/ LARGEST Q HAS SHORTEST T_c

$$Q_P = Q_2 + \left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right)\left(\frac{T_2}{T_1}\right) Q_1$$

$T_1 = 20.8$ $T_2 = 17.0$

$I_1 = 1.79$ $I_2 = 2.01$

$F_{m1} = 0.25$ $F_{m2} = 0.25$

$A_1 = 4.6$ $A_2 = 4.9$

$Q_1 = 6.4$ $Q_2 = 7.8$

$$Q_P = 7.8 + \left(\frac{2.01 - 0.25}{1.79 - 0.25}\right)\left(\frac{17.0}{20.8}\right)6.4$$

$Q_P = 13.8$

10-YEAR

#40 VELOCITY & DEPTH OF FLOW

$6.4/4.6 = 1.39$ $7.8/4.9 = 1.59$

AVE CFS/ACRE = 1.49

$\frac{1.49 \times 5.2}{2} = 3.9$

$Q_P = 13.8$

$13.8 + 3.9 = 17.7$

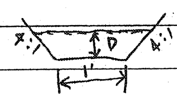
AVERAGE SLOPE = 0.1000

$$K' = \frac{Qn}{b^{8/3} S^{1/2}}$$

$$K' = \frac{17.7(0.030)}{(1)^{8/3}(0.100)^{1/2}}$$

$K' = 1.68 \Rightarrow 0.63 = D/b \Rightarrow D = 0.63$

$A = 2.22$



$V = Q/A = 17.7/2.22 = 8.0$

10-Y

#40 T_t VALUE

$$T_t = \frac{L}{V \cdot 60}$$

$$T_t = \frac{260}{8 \cdot 60} = 0.54$$

#40 INTENSITY & Q

$I = at^b$ $a = 10.209$ $b = -0.573$

$I = 10.209(17.5)^{-0.573}$

$I = 1.98$

$Q = 0.90(I - F_m)A$

$Q = 0.90(1.98 - 0.25)14.7$

$Q = 22.9$

#50 INTENSITY & Q 10-Y

$I = at^b \quad a = 10.209 \quad b = -0.573$

$I_2 = 10.209(19.5)^{-0.573}$

$I_2 = 1.86$

$Q = 0.90(I - F_M)A$

$Q_2 = 0.90(1.86 - 0.25)8.0$

$Q_2 = 11.6$

$I_1 = 10.209(18.8)^{-0.573}$

$I_1 = 1.90$

$Q_1 = 0.90(1.90 - 0.25)3.4$

$Q_1 = 5.0$

10-Y

#65 INTENSITY & Q

$I = at^b \quad a = 10.209 \quad b = -0.573$

$I = 10.209(8.2)^{-0.573}$

$I = 3.06$

$Q = 0.90(I - F_M)A$

$Q = 0.90(3.06 - 0.21)0.7$

$Q = 1.8$

CASE 2A @ #50 FOR 10Y

$T_1 < T_2$ USE CASE 2A

$T_2 = 19.5$	$T_1 = 18.8$
$I_2 = 1.86$	$I_1 = 1.90$
$F_{M2} = 0.25$	$F_{M1} = 0.25$
$A_2 = 8.0$	$A_1 = 3.4$
$Q_2 = 11.6$	$Q_1 = 5.0$

$$Q_p = Q_2 + \left(\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right) Q_1$$

$$Q_p = 11.6 + \left(\frac{1.86 - 0.25}{1.90 - 0.25}\right)(5.0)$$

$Q_p = 16.5$

#70 INTENSITY & Q 10-Y

$I = at^b \quad a = 10.209, \ b = -0.573$

$I = 10.209(10.0)^{-0.573}$

$I = 2.73$

$Q = 0.90(I - F_M)A$

$Q = 0.90(2.73 - 0.24)(2.5)$

$Q = 5.6$

10 Y

80 INTENSITY & Q

$I_{(t)} = a t^b$

$I = 10.209(16.0)^{-0.573}$

$I = 2.08$

$Q = 0.90(I - F_M)A$

$Q = 0.90(2.08 - 0.25)(4.7)$

$Q = 7.7$

#10 INTENSITY FOR 100-YEAR

$I = at^b$

$a = 15.56 \quad b = -0.573 \quad t = 20.0$

$I = 15.56(20.0)^{-0.573}$

$I = 2.80$

$t = 19.5$

$I = 15.56(19.5)^{-0.573}$

$I = 2.84$

$Q = 0.90(I - F_m)A$

$Q = 0.90(2.80 - 0.25)(8.1)$

$Q = 18.6$

$Q = 0.90(2.84 - 0.25)(5.6)$

$Q = 13.1$

CONFLUENCE

CASE 2A @ #10 FOR 100-Y

$T_1 < T_2$ USE CASE 2A

$T_2 = 20.0$	$T_1 = 19.5$
$I_2 = 2.80$	$I_1 = 2.84$
$F_{m2} = 0.25$	$F_{m1} = 0.25$
$A_2 = 8.1$	$A_1 = 5.6$
$Q_2 = 18.6$	$Q_1 = 13.1$

$$Q_P = Q_2 + \left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right) Q_1$$

$$Q_P = 18.6 + \left(\frac{2.80 - 0.25}{2.84 - 0.25}\right) 13.1$$

$Q_P = 31.5$

100-Y

#20 VELOCITY + DEPTH OF FLOW

$18.6/8.1 = 2.3 \quad 13.1/5.6 = 2.34$

AVE CFS/ACRE = 2.32

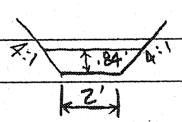
$\frac{2.32 \times 5.5}{2} = 6.4$

$Q_P = 31.5$

$31.5 + 6.4 = 37.9$

AVERAGE SLOPE = 0.0747

$$K' = \frac{Qn}{b^{8/3} s^{1/2}}$$



$$K' = \frac{37.9(0.030)}{(2)^{8/3}(0.0747)^{1/2}}$$

$K' = 0.66$

$0.66 \rightarrow 0.42 = D/b \rightarrow D = 0.84'$

$A = 4.50$

$V = Q/A = 37.9/4.50 = 8.4$

#20 T_t VALUE 100-Y

$$T_t = \frac{L}{V \cdot 60}$$

$$T_t = \frac{415}{8.4(60)} = 0.8$$

#20 INTENSITY + Q

$I = at^b \quad a = 15.56 \quad b = -0.573$

$I = 15.56(20.8)^{-0.573}$

$I = 2.73$

$Q = 0.90(I - F_m)A$

$I = 2.73, F_m = 0.25, A = 19.2$

$Q = 0.90(2.73 - 0.25)19.2$

$Q = 42.9$

#30 INTENSITY & Q FOR 100-Y

$I = at^{b}$

$a = 15.56 \quad b = -0.573$

$I = 15.56(20.8)^{-0.573}$

$I = 2.73$

$I = 15.56(17.0)^{-0.573}$

$I = 3.07$

$Q = 0.90(I - F_m)A$

$Q = 0.90(2.73 - 0.25)(4.6)$

$Q = 10.3$

$Q = 0.90(3.07 - 0.25)(4.9)$

$Q = 12.4$

100-YEAR

#40 VELOCITY & DEPTH OF FLOW

$10.3/4.6 = 2.24 \quad 12.4/4.9 = 2.53$

AVERAGE CFS/ACRE = 2.38

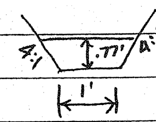
$\frac{2.38 \times 5.2}{2} = 6.2$

$Q_P = 22.0$

$22.0 + 6.2 = 28.2$

AVERAGE SLOPE = 0.1000

$K' = \frac{Qn}{b^{8/3} S^{1/2}}$



$K' = \frac{28.2(0.030)}{(1)^{8/3}(.100)^{1/2}}$

$K' = 2.68 \Rightarrow 0.77 = D/b \Rightarrow D = 0.77$

$A = 3.14$

$V = Q/A = 28.2/3.14 = 9.0$

CONFLUENCE CALC

CASE 2B @ #30 FOR 100-Y

WHERE
$>T_2$
STREAM W/
EST Q
SHORTEST
Tc

$Q_P = Q_2 + \left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right)\left(\frac{T_2}{T_1}\right) Q_1$

$T_1 = 20.8 \qquad T_2 = 17.0$

$I_1 = 2.73 \qquad I_2 = 3.07$

$F_{m1} = 0.25 \qquad F_{m2} = 0.25$

$A_1 = 4.6 \qquad A_2 = 4.9$

$Q_1 = 10.3 \qquad Q_2 = 12.4$

$Q_P = 12.4 + \left(\frac{3.07 - 0.25}{2.73 - 0.25}\right)\left(\frac{17.0}{20.8}\right) 10.3$

$Q_P = 22.0$

100-Y

#40 T_t VALUE

$T_t = \frac{L}{V \cdot 60}$

$T_t = \frac{260}{9 \cdot 60} = 0.5$

#40 INTENSITY & Q

$I = at^{b} \quad a = 15.56 \quad b = -0.573$

$I = 15.56(17.5)^{-0.573}$

$I = 3.02$

$Q = 0.90(I - F_m)A$

$Q = 0.90(3.02 - 0.25)14.7$

$Q = 36.6$

#50 INTENSITY & Q 100-Y

$I = at^b \quad a = 15.56 \quad b = -0.573$

$I_2 = 15.56(19.5)^{-0.573}$

$I_2 = 2.84$

$Q = 0.90(I - F_m)A$

$Q_2 = 0.90(2.84 - 0.25)8.0$

$Q_2 = 18.6$

$I_1 = 15.56(18.8)^{-0.573}$

$I_1 = 2.90$

$Q_1 = 0.90(2.90 - 0.25)3.4$

$Q_1 = 8.1$

100-Y

#65 INTENSITY & Q

$I = at^b \quad a = 15.56 \quad b = -0.573$

$I = 15.56(8.2)^{-0.573}$

$I = 4.66$

$Q = 0.90(I - F_m)A$

$Q = 0.90(4.66 - 0.21)(0.7)$

$Q = 2.8$

CONFLUENCE CALC

CASE 2A @ #50 FOR 100 Y

$T_1 < T_2$ ~~USE CASE 2A~~

$T_2 = 19.5$	$T_1 = 18.8$
$I_2 = 2.84$	$I_1 = 2.90$
$F_{M2} = 0.25$	$F_{M1} = 0.25$
$A_2 = 8.0$	$A_1 = 3.4$
$Q_2 = 18.6$	$Q_1 = 8.1$

$$Q_p = Q_2 + \left(\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right) Q_1$$

$$Q_p = 18.6 + \left(\frac{2.84 - 0.25}{2.90 - 0.25}\right) 8.1$$

$Q_p = 26.5$

#70 INTENSITY & Q 100-Y

$I = at^b \quad a = 15.56 \quad b = -0.573$

$I = 15.56(10.0)^{-0.573}$

$I = 4.16$

$Q = 0.90(I - F_m)A$

$Q = 0.90(4.16 - 0.24)(2.5)$

$Q = 8.8$

100 Y

#80 INTENSITY & Q

$I_{(t)} = at^b$

$I = 15.56(16.0)^{-0.573}$

$I = 3.18$

$Q = 0.90(I - F_m)A$

$Q = 0.90(3.18 - 0.25)(4.7)$

$Q = 12.4$

DEVELOPED CONDITON HYDROLOGY

RATIONAL METHOD STUDY FORM DEVELOPED CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 10 -YEAR STORM RATIONAL METHOD STUDY	Calculated by RAS Date 12-21-09 Checked by ____ Date ____ Page 1 of 3

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 10	6.3	6.3	C	NAT	—	20.4	1.81	0.25	0.25	8.8	985	0.1970	—	INITIAL SUBAREA
(Q_1) 10	5.8	5.8	C	NAT	—	19.8	1.84	0.25	0.25	8.3	835	0.1569	—	INITIAL SUBAREA
$T_2 > T_1$ USE CASE 2A Q_p	= 8.8 +	$\left(\frac{1.81-0.25}{1.84-0.25}\right)$ 8.3				A_p	= 5.8	+ 6.3		$T_p = 20.4$				CONFLUENCE ANALYSIS FOR PT. # 10
Q_p	= 16.9					A_p	= 12.1							
10		12.1				20.4				16.9				STREAM SUMMARY
(Q_2) 20	3.9	16.0	C	NAT	0.9	21.3	1.77	0.25	0.25	21.9	375	0.0747	7.2	NATURAL STREAM b=1.0', Z=4, n=.030, D=0.72'
24	2.8	2.8	C	S.F.	—	11.9	2.47	0.13	0.13	5.9	1,000	0.0432	—	INITIAL SUBAREA
26	2.4	5.2	C	S.F.	1.0	12.9	2.36	0.15	0.14	10.4	385	0.0725	6.4	STREET FLOW
(Q_1) 20	—	5.2			1.1	14.0	2.25		0.14	10.4	485'	0.1278	7.4	NATURAL STREAM b=1.0 Z=4 n=.030 D=0.48
$T_2 > T_1$ USE CASE 2A	$Q_p = 21.9$	+ $\left(\frac{1.77-0.14}{2.25-0.14}\right)$ 10.4				A_p A_p	= 16.0 = 21.2	+ 5.2	$T_p =$ $T_p =$	T_2 21.3				CONFLUENCE ANALYSIS FOR PT. # 20
	Q_p = 29.9													
20		21.2				21.3				29.9				STREAM SUMMARY

Figure D-4

RATIONAL METHOD STUDY FORM DEVELOPED CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 10 -YEAR STORM RATIONAL METHOD STUDY	Calculated by RAS Date 12-21-09 Checked by ___ Date ___ Page 2 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
					—						510	0.1686	—	INITIAL SUBAREA
30	3.4	3.4	C	NAT.		16.5	2.05	0.25	0.25	5.5				
					0.2						210	0.1333	15.1	PIPE FLOW 18"
32	—	3.4				16.7	2.03		0.25	5.5				
					0.5						165	0.1091	6.1	STREAM SUMMARY
(Q1) 34	0.5	3.9	C	NAT		17.2	2.00	0.25	0.25	6.1				
					—						380	0.3158	—	INITIAL SUBAREA
37	1.7	1.7	C	NAT.		13.1	2.34	0.25	0.25	3.2				
					0.2						150	0.140	13.7	PIPE FLOW 18"
38	0.8	2.5	C	SF		13.3	2.32	0.22	0.24	4.7				
					0.3						155	0.1613	7.5	NATURAL STREAM b=1.0' Z=4 n=0.03 D=0.39'
(Q2) 34	3.0	5.5	C	NAT		13.6	2.29	0.25	0.25	10.1				
$T_1 > T_2$ USE CASE 2B	$Q_P = Q_2 + \left(\frac{I_2 - F_{M2}}{I_1 - F_{M1}}\right)\left(\frac{T_2}{T_1}\right) Q_1$						$A_P = A_1 + A_2$			$T_P = T_2$				
	$Q_P = 10.1 + \left(\frac{2.29 - 0.25}{2.00 - 0.25}\right)\left(\frac{13.6}{17.2}\right)$				6.1		$A_P =$ 3.9 + 5.5 $A_P =$ 9.4			$T_P = 13.6$				
	$Q_P =$	15.7												
														STREAM SUMMARY
34		9.4				13.6			0.25	15.7				
					0.5						260	0.100	8.1	NATURAL STREAM b=1.0' Z=4' n=0.030 D=.66'
40	4.5	13.9	C	NAT		14.1	2.24	0.25	0.25	24.9				
					—						595	0.0111	—	INITIAL SUBAREA
45	1.3	1.3	C	SF		12.2	2.44	0.12	0.12	2.7				
											2.4 / 0.3	IS PICKED UP IN C.B. WILL FLOW TO # 56		
45		1.2				12.2			0.12	2.4				
					1.9						680	0.1956	5.9	NATURAL STREAM b=1.0 Z=4 n=0.030 D=0.22'
(Q3) 50		1.2				14.1	2.24		0.12	2.4				

Figure D-4

RATIONAL METHOD STUDY FORM — DEVELOPED CONDITION

ORANGE COUNTY HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA

10-YEAR STORM RATIONAL METHOD STUDY

Calculated by RAS Date 12-21-09
Checked by ____ Date ____
Page 3 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 50	7.0	7.0	C	NAT	—	19.3	1.87	0.25	0.25	10.2	785'	0.178	—	INITIAL SUBAREA
(Q_1) 50	2.8	2.8	C	NAT	—	18.4	1.92	0.25	0.25	4.2	695'	0.1827	—	INITIAL SUBAREA
$T_2 > T_1 > T_3$ USE CASE 2A	$Q_P = Q_2$	$+ \left[\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right] Q_1$	$+ \left[\frac{I_2 -}{I_3 -}\right.$		$\left.\frac{F_{M3}}{F_{M3}}\right]$	Q_3	$A_P =$ $T_P =$	$A_1 + A_2$ $T_2 =$	$+ A_3 =$ 19.3	11.0				
	$Q_P = 10.2$	$+ 4.1$	$+ 2.0$	$= 16.3$										
50		11.0				19.3				16.3				STREAM SUMMARY
45		0.1				12.2			0.12	0.3				CARRY OVER FROM C.B.
56	2.4	2.5	C	SF	3.4	15.6	2.12	0.17	0.17	4.4	1,170'	0.0997	5.7	STREET FLOW
70	1.4	3.9	C	NAT	0.9	16.5	2.05	0.23	0.19	6.5	285'	0.0597	5.1	STREET FLOW
65	0.7	0.7	C	SF	—	7.5	3.22	0.18	0.18	1.9	460'	0.191	—	INITIAL SUBAREA
80	3.8	3.8	C	NAT	—	16.9	2.02	0.25	0.25	6.1	690'	0.2536	—	INITIAL SUBAREA

Figure D-4

RATIONAL METHOD STUDY FORM DEVELOPED CONDITION

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: TTM 17325 IN COTO DE CAZA 100 -YEAR STORM RATIONAL METHOD STUDY	Calculated by RAS Date 1-05-10 Checked by ____ Date ____ Page 1 of 3

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
(Q_2) 10	6.3	6.3	C	NAT	—	20.4	2.76	0.25	0.25	14.2	985	0.1970	—	INITIAL SUBAREA
(Q_1) 10	5.8	5.8	C	NAT	—	19.8	2.81	0.25	0.25	13.4	835	0.1569	—	INITIAL SUBAREA
$T_2 > T_1$ USE CASE 2A Q_p	$= 14.2 +$	$\left(\frac{2.76-0.25}{2.81-0.25}\right)$	13.4			A_p	$= 5.8$	$+ 6.3$		$T_p = 20.4$				CONFLUENCE ANALYSIS FOR PT. # 10
Q_p	$= 27.3$					A_p	$= 12.1$							STREAM SUMMARY
10		12.1				20.4				27.3				
(Q_2) 20	3.9	16.0	C	NAT	0.8	21.2	2.70	0.25	0.25	35.3	375	0.0747	8.3	NATURAL STREAM b=1.0', Z=4, n=.030, D=0.86'
24	2.8	2.8	C	S.F.	—	11.9	3.76	0.13	0.13	9.1	1,000	0.0432	—	INITIAL SUBAREA
26	2.4	5.2	C	S.F.	0.9	12.8	3.61	0.15	0.14	16.2	385	0.0725	7.1	STREET FLOW
(Q_1) 20	—	5.2			1.0	13.8	3.46		0.14	16.2	485'	0.1278	7.4	NATURAL STREAM b=1.0 Z=4 n=.030 D=0.58
$T_2 > T_1$ USE CASE 2A	$Q_p = 35.3 +$	$\left(\frac{2.70-0.14}{3.46-0.14}\right)$	16.2			A_p	$= 16.0$	$+ 5.2$	$T_p =$	T_2				CONFLUENCE ANALYSIS FOR PT. # 20
	$Q_p = 47.8$					A_p	$= 21.2$		$T_p =$	21.2				
														STREAM SUMMARY
20		21.2				21.2				47.8				

RATIONAL METHOD STUDY FORM DEVELOPED CONDITION

ORANGE COUNTY
HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA
100 -YEAR STORM RATIONAL METHOD STUDY

Calculated by RAS Date 1-05-10
Checked by ______ Date ______
Page 2 of 3

Concentration Point	Area (Acres) Subarea	Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
30	3.4	3.4	C	NAT.	—	16.5	3.12	0.25	0.25	8.8	510	0.1686	—	INITIAL SUBAREA
					0.2						210	0.1333	17.3	PIPE FLOW 18"
32	—	3.4				16.7	3.10		0.25	8.8				
					0.4						165	0.1091	7.0	STREAM SUMMARY
(Q_1) 34	0.5	3.9	C	NAT		17.1	3.06	0.25	0.25	9.9				
					—						380	0.3158	—	INITIAL SUBAREA
37	1.7	1.7	C	NAT.		13.1	3.56	0.25	0.25	5.1				
					0.2						150	0.140	15.5	PIPE FLOW 18"
38	0.8	2.5	C	SF		13.3	3.53	0.22	0.24	7.4				
					0.3						155	0.1613	8.4	NATURAL STREAM b=1.0' Z=4 n=0.03 D=0.48'
(Q_2) 34	3.0	5.5	C	NAT		13.6	3.49	0.25	0.25	16.0				
$T_1 > T_2$ USE CASE 2B	$Q_P = Q_2 + \left(\frac{I_2 - Fm_1}{I_1 - Fm_1}\right)\left(\frac{T_2}{T_1}\right) Q_1$						$A_P = A_1 + A_2$			$T_P = T_2$				
	$Q_P = 16.0 + \left(\frac{3.49 - 0.25}{3.06 - 0.25}\right)\left(\frac{13.6}{17.1}\right)$						$A_P =$ 3.9 + 5.5 $A_P =$ 9.4			$T_P = 13.6$				
	$Q_P =$	25.1												STREAM SUMMARY
34		9.4				13.6			0.25	25.1				
					0.5						260	0.106	9.1	NATURAL STREAM b=1.0' Z=4' n=0.030 D=.81'
40	4.5	13.9	C	NAT		14.1	3.42	0.25	0.25	39.7				
					—						595	0.0111	—	INITIAL SUBAREA
45	1.3	1.3	C	SF		12.2	3.71	0.12	0.12	4.0	3.0 1.0	IS PICKED UP WILL FLOW		IN C.B. TO # 56
45		1.0				12.2			0.12	3.0				
					1.8						680	0.1956	6.4	NATURAL STREAM b=1.0 Z=4 n=0.030 D=0.24'
(Q_3) 50		1.0				14.0	3.43		0.12	3.0				

Figure D-4

RATIONAL METHOD STUDY FORM DEVELOPED CONDITION

ORANGE COUNTY
HYDROLOGY MANUAL

STUDY NAME: TTM 17325 IN COTO DE CAZA
100 -YEAR STORM RATIONAL METHOD STUDY

Calculated by RAS Date 1-05-10
Checked by ______ Date ______
Page 3 of 3

Concentration Point	Area (Acres)		Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
	Subarea	Total												
(Q_2) 50	7.0	7.0	C	NAT	—	19.3	2.85	0.25	0.25	16.4	785'	0.178	—	INITIAL SUBAREA
(Q_1) 50	2.8	2.8	C	NAT	—	18.4	2.93	0.25	0.25	6.8	695'	0.1827	—	INITIAL SUBAREA
$T_2 > T_1 > T_3$ USE CASE 2A	$Q_p = Q_2 + \left[\frac{I_2 - F_{m1}}{I_1 - F_{m1}}\right] Q_1 + \left[\frac{I_2 - F_{m3}}{I_3 - F_{m3}}\right] Q_3$						$A_p =$ $T_p =$	$A_1 + A_2$ $T_2 =$	$+ A_3 =$ 19.3	10.8				
	$Q_p = 16.4$	$+ 6.6$	$+ 2.5$	$= 25.5$										
50		10.8				19.3				25.5				STREAM SUMMARY
														CARRY OVER FROM C.B.
45		0.3				12.2			0.12	1.0				
56	2.4	2.7	C	SF	3.0	15.2	3.27	0.17	0.16	7.6	1,170'	0.0997	6.5	STREET FLOW
70	1.4	4.1	C	NAT	0.8	16.0	3.18	0.23	0.18	11.1	285'	0.0597	6.2	STREET FLOW
65	0.7	0.7	C	SF	—	7.5	4.90	0.18	0.18	3.0	460'	0.191	—	INITIAL SUBAREA
80	3.8	3.8	C	NAT	—	16.9	3.08	0.25	0.25	9.7	690'	0.2536	—	INITIAL SUBAREA

Figure D-4

(DEVELOPED CONDITION)

BACK-UP

CALCULATIONS

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

F_M, LOSS RATE CALCULATIONS FOR DEVELOPED AREAS

- STREETS : 34' RIGHT-OF-WAY WIDTH
  29' IMPERVIOUS WIDTH
  5' PERVIOUS WIDTH

  USE RATIO OF STREET AREA FOR IMPERVIOUS
  $29/34 = 0.85$ ∴ USE 85% OF ST. AREA FOR IMPERVIOUS AREA

- RESIDENTIAL LOTS :

IMPERVIOUS AREAS	ROOF	—	70' × 80'	=	5,600 SF
	POOL/HARDSCAPE	—	40' × 100'	=	4,000 SF
	DRIVEWAYS	—	40' × 30'	=	1,200 SF
	MISC. WALKWAYS	—	6' × 200'	=	1,200 SF
			TOTAL	=	12,000 SF

- THE FOLLOWING PAGES ARE F_M CALCULATIONS FOR AREAS INVOLVING STREETS AND RESIDENTIAL LOTS.

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 22 TO 24

TOTAL AREA = 2.8 Ac.

RESIDENTIAL LOTS 3, 4 & 5 ⟶ 3 × 12,000 = 36,000 SF

STREET AREA = 26,140 SF

85 % OF STREET AREA = 22,219 SF

TOTAL IMPERVIOUS AREA = 36,000 + 22,219

= 58,219 SF

= 1.34 Ac

TOTAL PERVIOUS AREA = 2.80 − 1.34 = 1.46 AC.

$\therefore \quad a_p = \dfrac{1.46}{2.80} = 0.52$

PER TABLE C.2 FOR SOIL "C" $F_p = 0.25$

$F_m = a_p F_p = (0.52)(0.25) = \underline{0.13}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

NODES 24 TO 26

TOTAL AREA = 2.4 AC.

RESIDENTIAL LOTS 6 & 7 → 2 × 12,000 = 24,000 SF

STREET AREA = 22,220 SF

85% OF STREET AREA = 18,887 SF

TOTAL IMPERVIOUS AREA = 24,000 + 18,887

= 42,887 SF

= 0.98 AC

TOTAL PERVIOUS AREA = 2.40 − 0.98 = 1.42 AC

$\therefore a_p = \dfrac{1.42}{2.40} = 0.59$

PER TABLE C.2 FOR SOIL "C" $F_p = 0.25$

$F_M = a_p F_p = (0.59)(0.25) = \underline{0.15}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 37 TO 38

TOTAL AREA = 0.8 AC.

PORTION OF LOT 7 - ASSUME AN ADDITIONAL IMPERVIOUS COVER OF 5,000 SF DUE TO THE SIZE OF THE LOT.

$\longrightarrow$ 5,000 SF

STREET AREA = 0 SF

TOTAL IMPERVIOUS AREA = 5,000 SF = 0.11 AC.

TOTAL PERVIOUS AREA = 0.80 - 0.11 = 0.69 AC

$\therefore \quad a_P = \frac{0.69}{0.80} = 0.86 \qquad F_P = 0.25$

$F_M = a_P F_P = (0.86)(0.25) = \underline{0.22}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 42 TO 45

TOTAL AREA = 1.3 AC.

RESIDENTIAL LOTS 1&2 ⟶ 2 × 12,000 = 24,000 SF

STREET AREA = 7,600 SF

85 % OF STREET AREA = 6,460 SF

TOTAL IMPERVIOUS AREA = 24,000 + 6,460

= 30,460 SF

= 0.70 AC.

TOTAL PERVIOUS AREA = 1.30 − 0.70 = 0.60 AC.

$\therefore a_p = \frac{0.60}{1.30} = 0.46$ $F_p = 0.25$

$F_M = a_p F_p = (0.46)(0.25) = \underline{0.12}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 45 TO 56

TOTAL AREA = 2.4 AC.

NO RESIDENTIAL LOTS

STREET AREA = 41,810 SF

85 % OF STREET AREA = 35,539 SF

TOTAL IMPERVIOUS AREA = 35,539 SF

= 0.82 AC

TOTAL PERVIOUS AREA = 2.40 − 0.82 = 1.58 AC.

$\therefore\ a_p = \frac{1.58}{2.40} = 0.66 \qquad F_p = 0.25$

$F_M = a_p F_p = (0.66)(0.25) = \underline{0.17}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 56 TO 70

TOTAL AREA = 1.4 AC.

STREET AREA = 20' x 275' = 5,500 SF

CONC. GUTTER = 3' x 150' = 450 SF

TOTAL = 5,950 SF

= 0.14 AC. (Impervious)

TOTAL PERVIOUS AREA = 1.40 - 0.14 = 1.26 AC.

$\therefore\ a_p = \frac{1.26}{1.40} = 0.90$

PER TABLE C.2 FOR SOIL "C" $F_p = 0.25$

$F_m = a_p F_p = (0.90)(0.25) = \underline{0.23}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

NODES 60 TO 65

TOTAL AREA = 0.7 AC.

NO RESIDENTIAL LOTS

PRIVATE STREET AREA = 5,300 SF

85% OF STREET AREA = 4,505 SF

VAN GOGH STREET AREA + CONC. GUTTER = 4,520 SF

TOTAL IMPERVIOUS AREA = 9,025 SF

= 0.21 AC

TOTAL PERVIOUS = 0.70 − 0.21 = 0.49

$\therefore\ a_p = \frac{0.49}{0.70} = 0.70 \qquad F_p = 0.25$

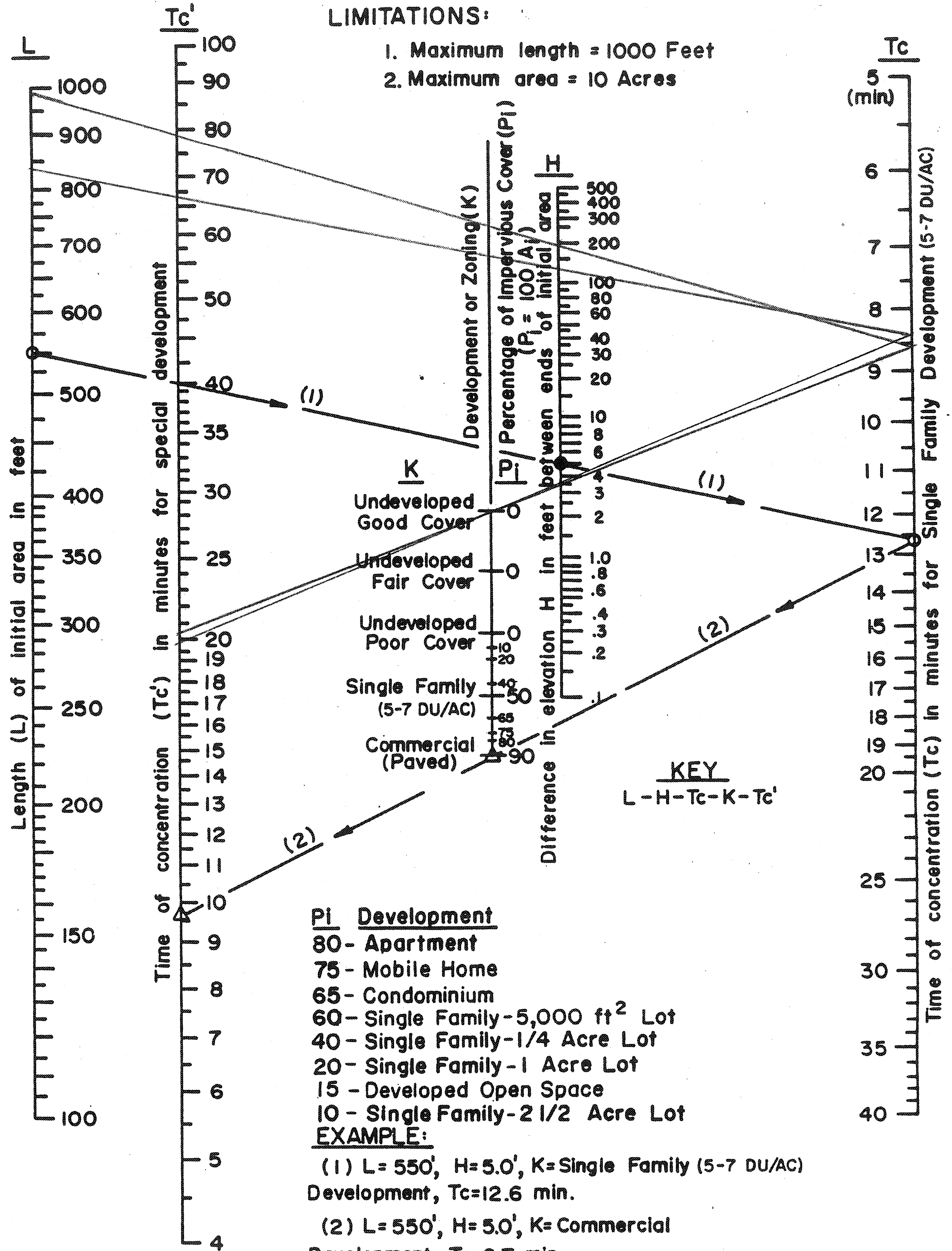
$F_M = a_p F_p = (0.70)(0.25) = \underline{0.18}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (951) 785-5122 FAX (951) 785-5180

#10 DEV. COND.

LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres



KEY

L - H - Tc - K - Tc'

Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family - 5,000 ft^2 Lot
40	Single Family - 1/4 Acre Lot
20	Single Family - 1 Acre Lot
15	Developed Open Space
10	Single Family - 2 1/2 Acre Lot

EXAMPLE:

(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.

(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.

ORANGE COUNTY

HYDROLOGY MANUAL

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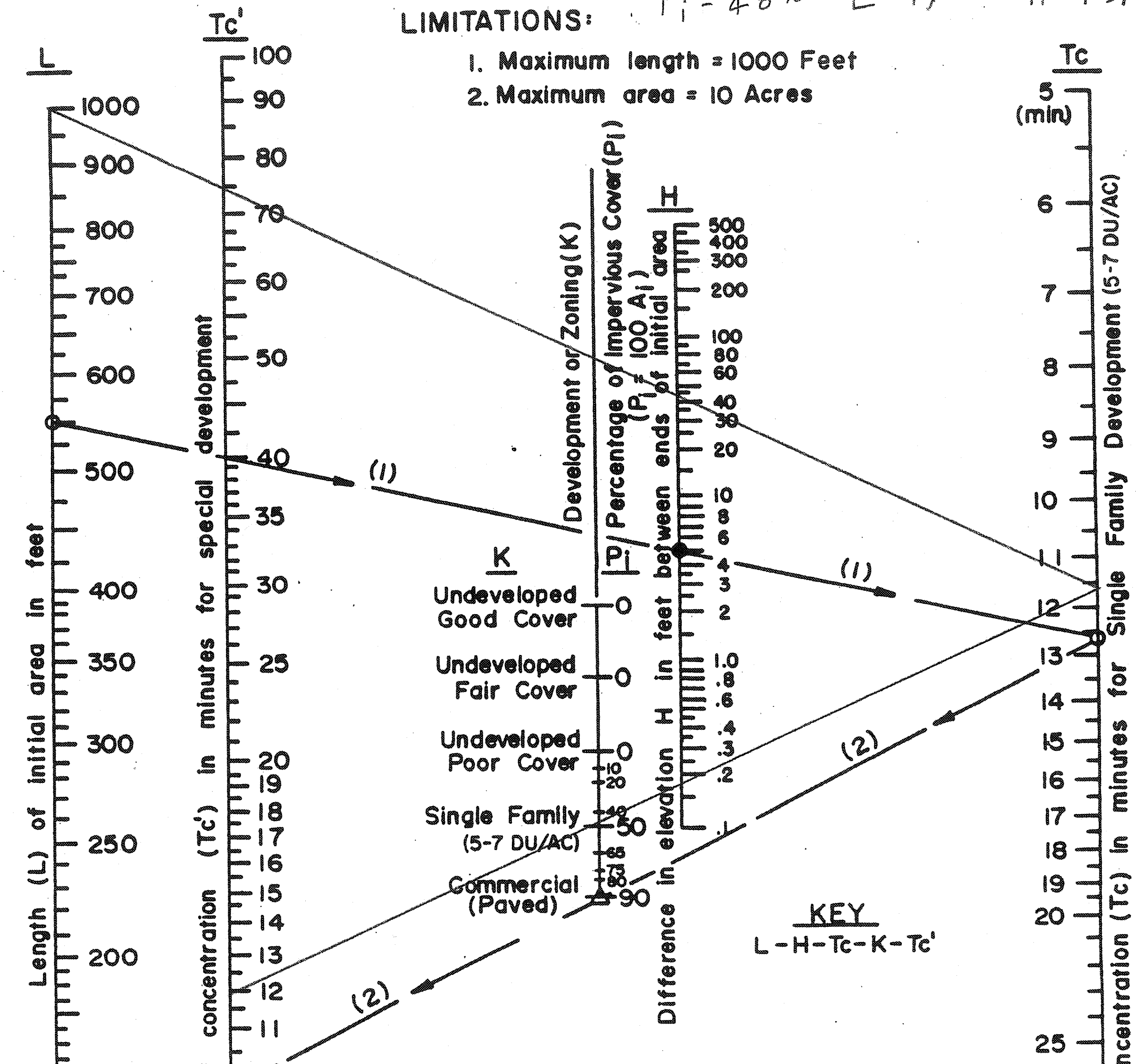
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#24 DEV. COND.

P_i = 48% L = 1,000' H = 43.2



LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres

Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family - 5,000 ft² Lot
40	Single Family - 1/4 Acre Lot
20	Single Family - 1 Acre Lot
15	Developed Open Space
10	Single Family - 2 1/2 Acre Lot

EXAMPLE:

(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.

(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.

ORANGE COUNTY
HYDROLOGY MANUAL

(49)

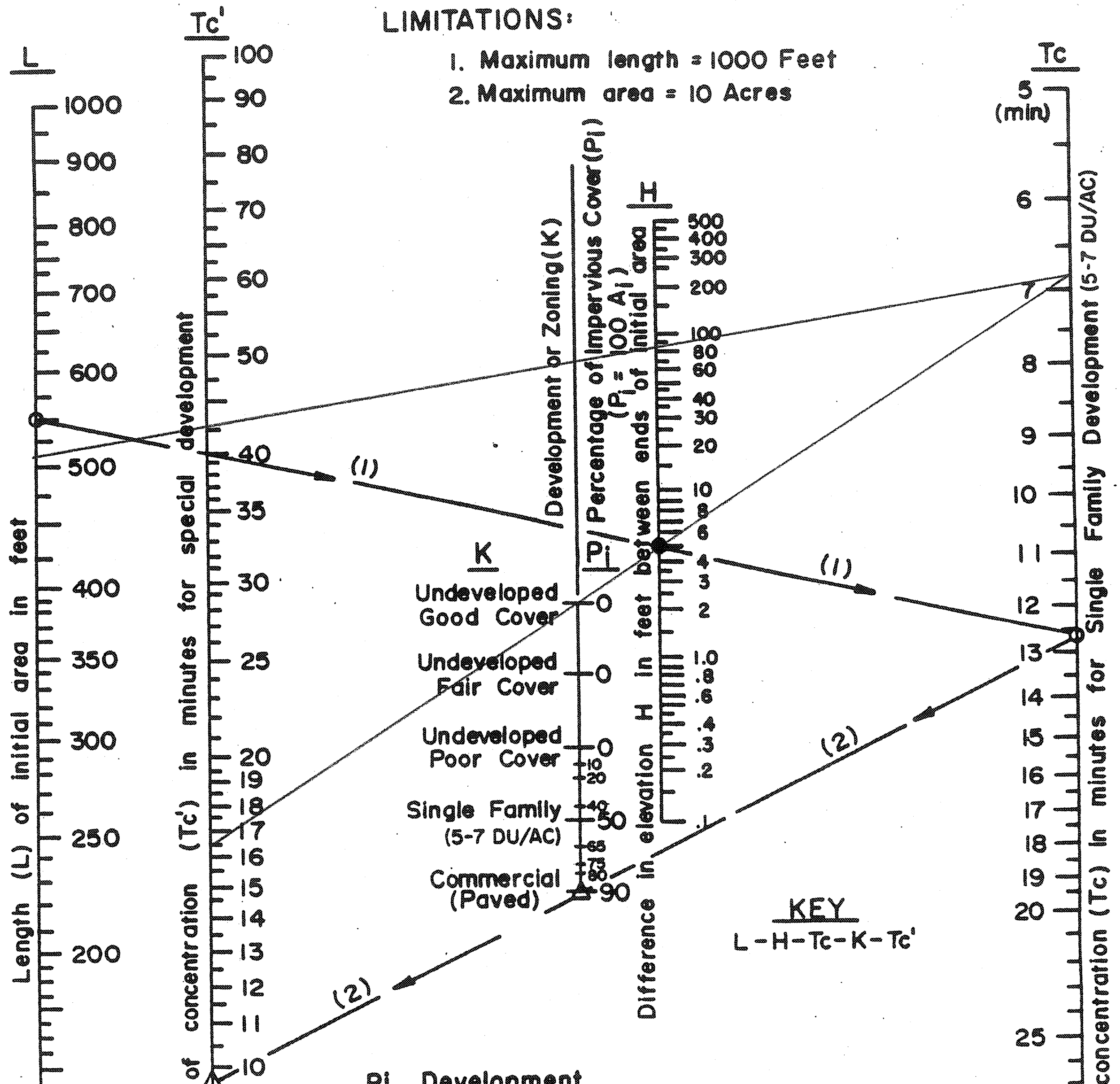
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

30 DEV. COND.

LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres



Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family-5,000 ft^2 Lot
40	Single Family-1/4 Acre Lot
20	Single Family-1 Acre Lot
15	Developed Open Space
10	Single Family-2 1/2 Acre Lot

EXAMPLE:

(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.

(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.

ORANGE COUNTY
HYDROLOGY MANUAL

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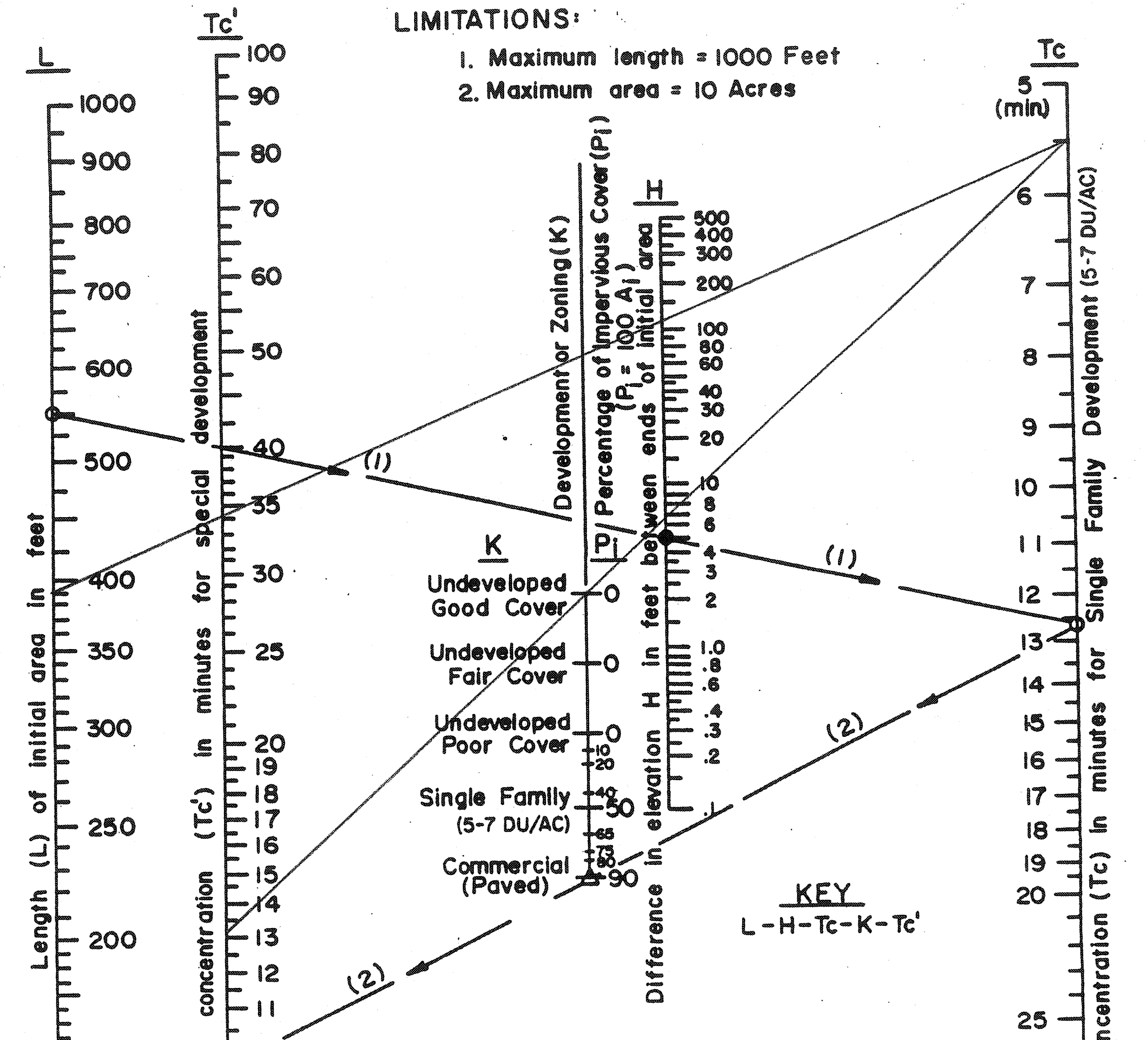
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#37 DEV. COND.



Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family-5,000 ft^2 Lot
40	Single Family-1/4 Acre Lot
20	Single Family-1 Acre Lot
15	Developed Open Space
10	Single Family-2 1/2 Acre Lot

EXAMPLE:

(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.

(2) L= 550', H= 5.0', K= Commercial Development, Tc= 9.7 min.

ORANGE COUNTY

HYDROLOGY MANUAL

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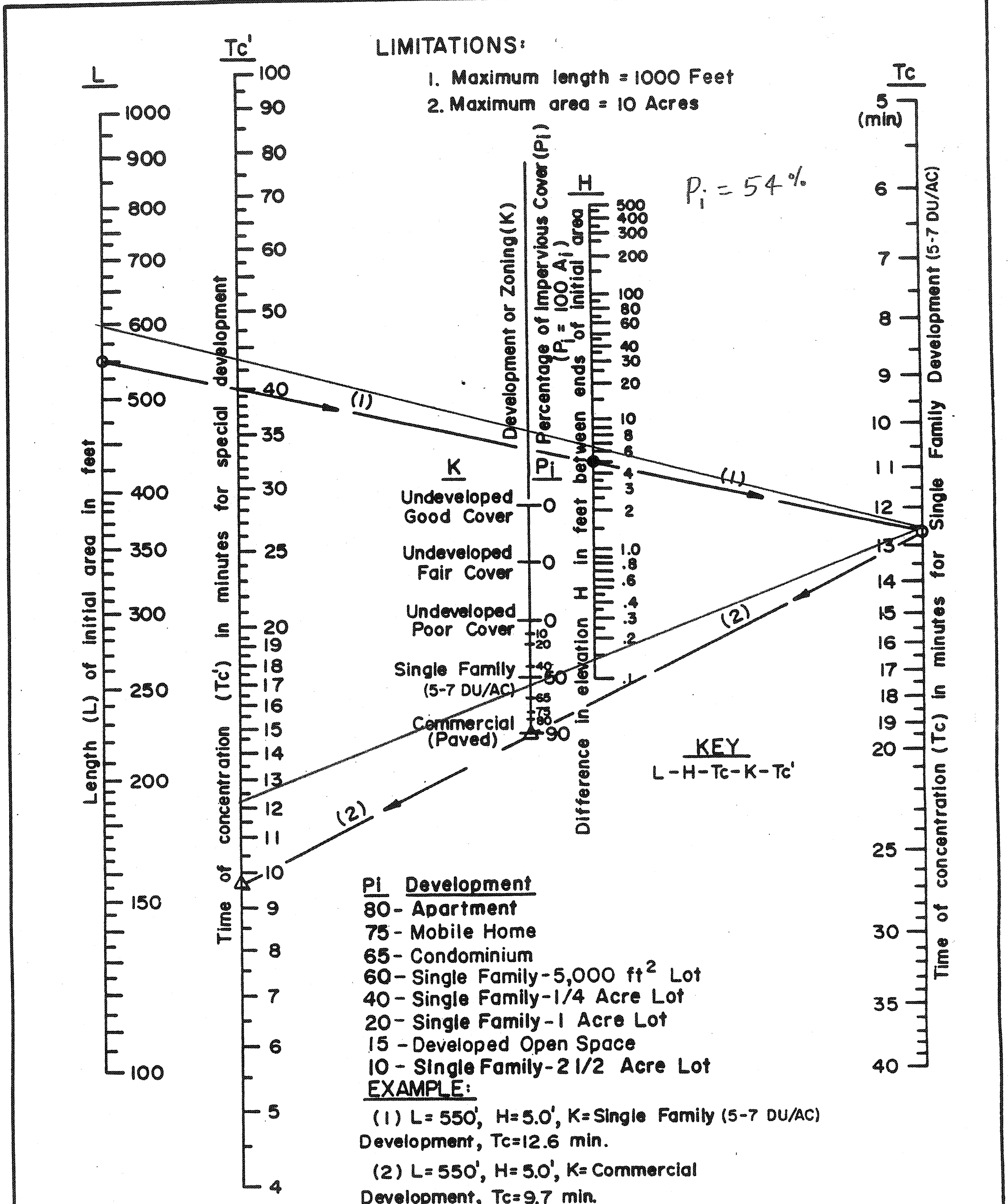
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

45

DEV. COND.



ORANGE COUNTY

HYDROLOGY MANUAL

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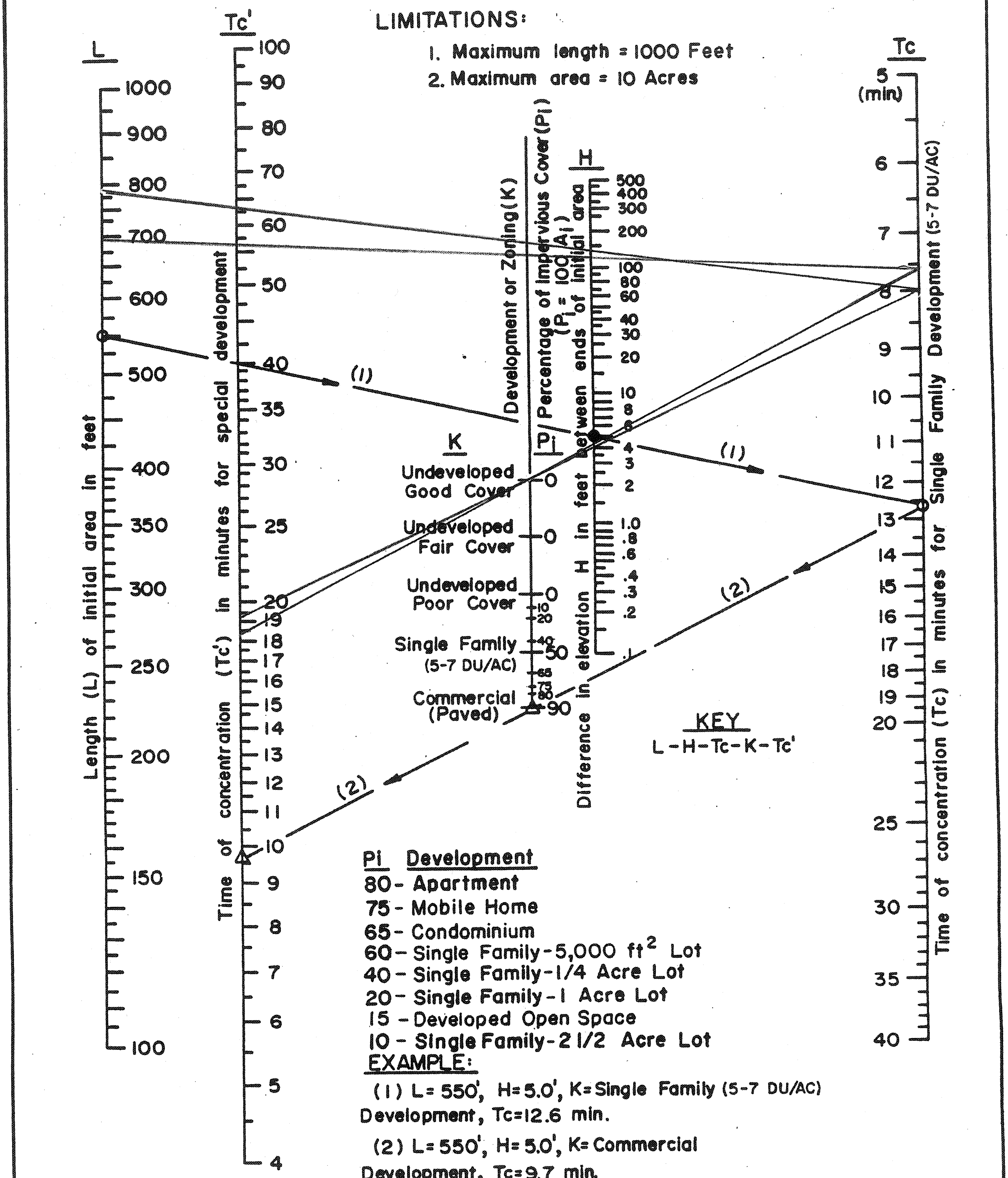
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#50 DEV. COND.



ORANGE COUNTY

HYDROLOGY MANUAL

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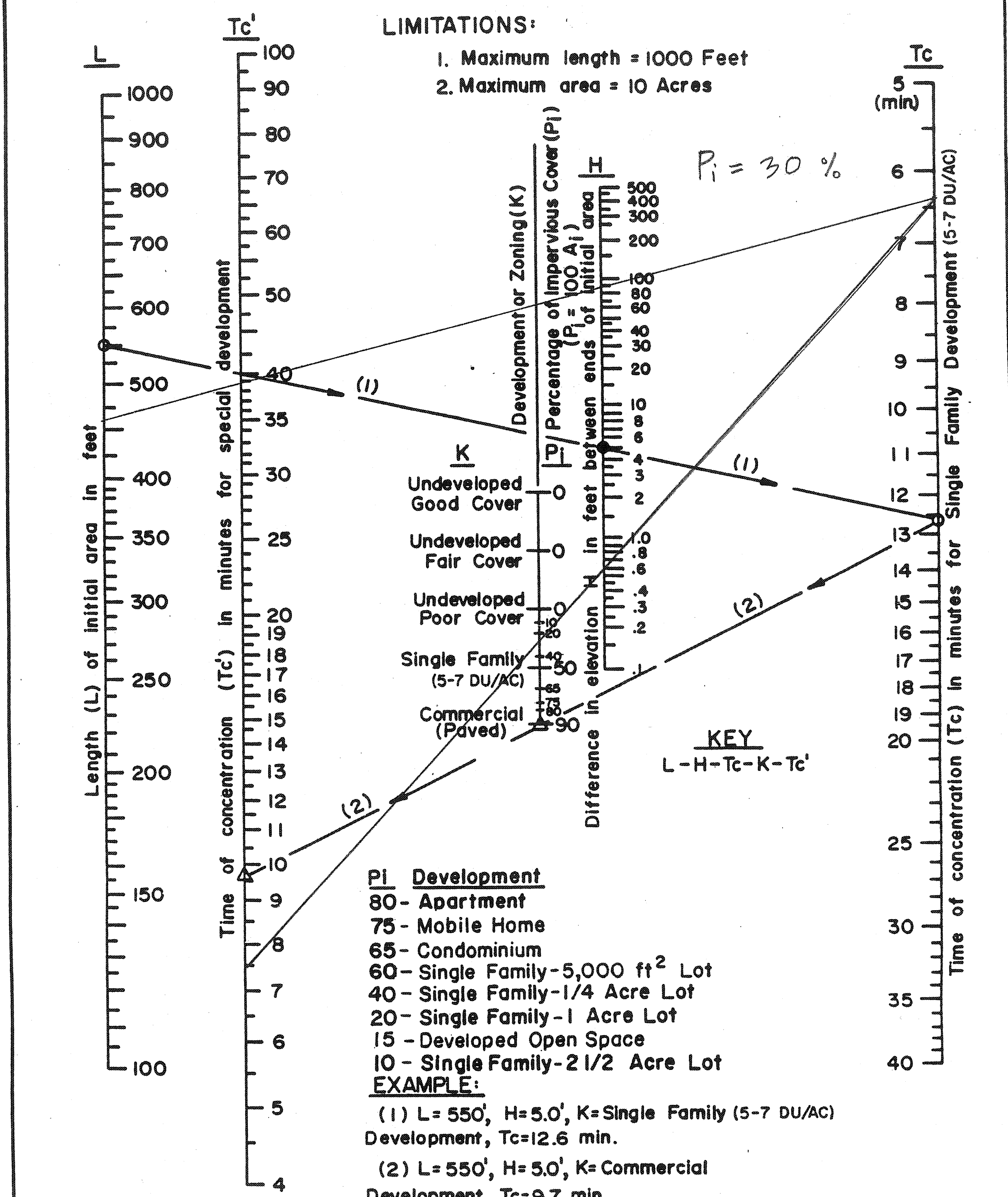
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

65

DEV. COND.



ORANGE COUNTY

HYDROLOGY MANUAL

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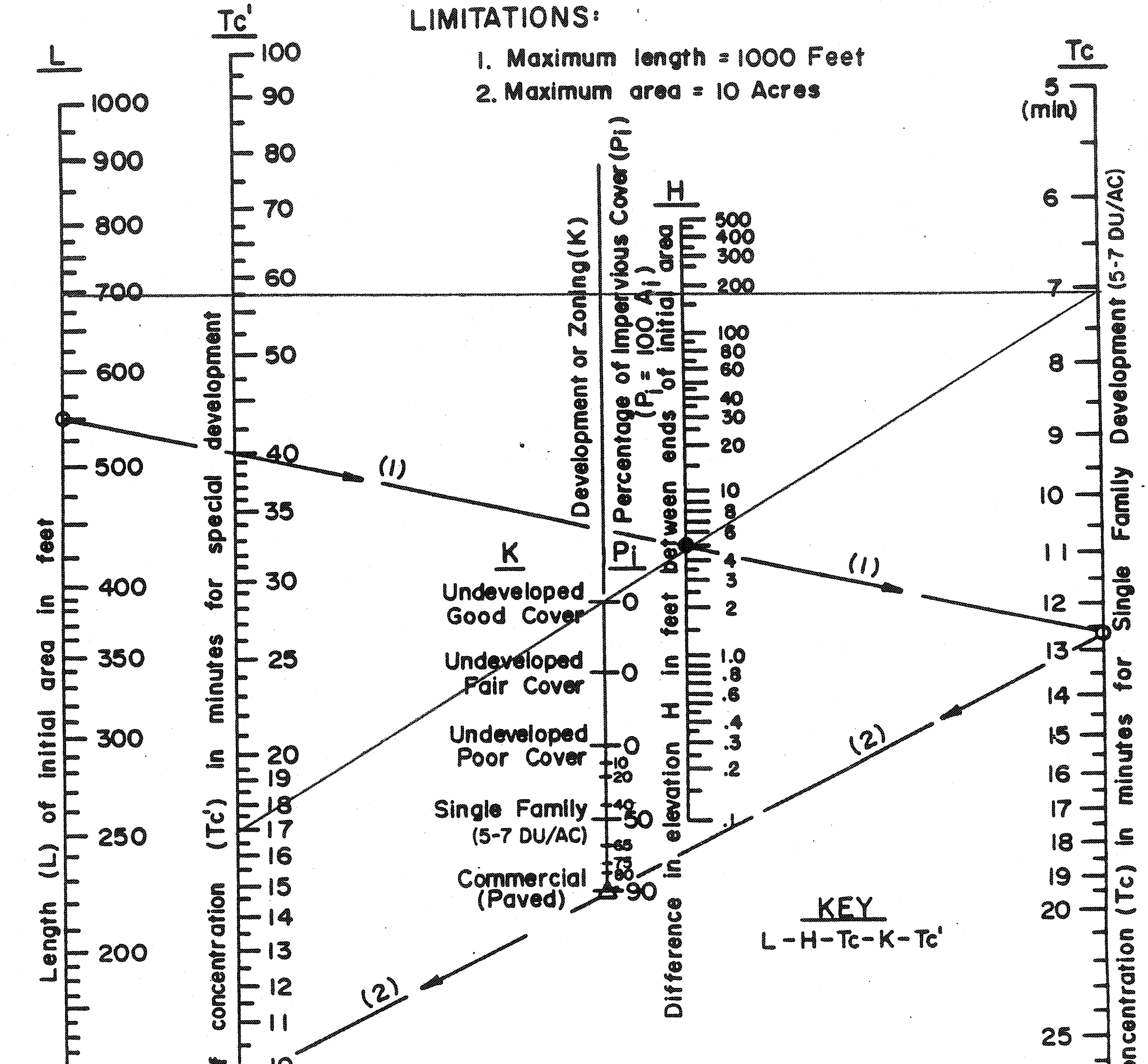
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

#80 DEV. COND.

LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres



Pi	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family-5,000 ft^2 Lot
40	Single Family-1/4 Acre Lot
20	Single Family-1 Acre Lot
15	Developed Open Space
10	Single Family-2 1/2 Acre Lot

EXAMPLE:

(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.

(2) L= 550', H= 5.0', K= Commercial Development, Tc= 9.7 min.

ORANGE COUNTY

HYDROLOGY MANUAL

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TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10 Y

10 INTENSITY & Q

$I_{(t)} = at^b$

$I_2 = 10.209\,(20.4)^{-0.573}$

$I_2 = 1.81$

$Q_2 = 0.90(I - F_m)\,A$

$Q_2 = 0.90(1.81 - 0.25)\,6.3$

$Q_2 = 8.8$

$I_1 = 10.209\,(19.8)^{-0.573}$

$I_1 = 1.84$

$Q_1 = 0.90\,(1.84 - 0.25)\,5.8$

$Q_1 = 8.3$

10-Y

(Q2) # 20 Velocity & Depth of Flow

~~$\frac{8.8}{6.3} = 1.40$~~ ~~$\frac{8.3}{5.8} = 1.43$~~ ~~AVG. = 1.42~~

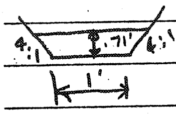
AVG. $Q = \frac{1.42 \times 3.9}{2} + 16.9 = 19.7$

~~AVG. SLOPE = 0.0747~~

$Q = K'/n\, b^{8/3} S^{1/2}$

$Q = 19.7,\ n = .030,\ b = 1',\ S = 0.0747$

$K' = \frac{Qn}{b^{8/3} S^{1/2}} = 2.16$



$D/b = 0.71 \longrightarrow D = 0.71'$

$A = 2.73$

$V = Q/A = 19.7/2.73 = 7.2$ FT/SEC.

$T_t = \frac{L}{(V)(60)} = \frac{375}{(7.2)(60)} = 0.9$

10-Y CONFLUENCE

$T_2 > T_1$ @ # 10

USE CASE 2A

$T_2 = 20.4$	$T_1 = 19.8$
$I_2 = 1.81$	$I_1 = 1.84$
$F_{M_2} = 0.25$	$F_{M_1} = 0.25$
$A_2 = 6.3$	$A_1 = 5.8$
$Q_2 = 8.8$	$Q_1 = 8.3$

$Q_p = Q_2 + \left(\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right) Q_1$

$Q_p = 8.8 + \left(\frac{1.81 - 0.25}{1.84 - 0.25}\right) 8.3$

$Q_p = 16.9$

10-Y

(Q2) # 20 INTENSITY & Q

$T_{c_2} = 21.3$

$I_2 = 10.209\,(21.3)^{-0.573}$

$I_2 = 1.77$

$Q_2 = 0.90\,(1.77 - 0.25)\,16.0$

$Q_2 = 21.9$

10-Y

#24 INTENSITY & Q

$I = 10.209(11.9)^{-0.573}$

$I = 2.47$

$Q = 0.90(2.47-0.13)\,2.8$

$= 5.9$

10-Y

#26 velocity

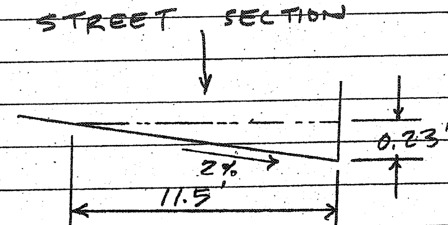
~~UPSTREAM~~ $Q/_{AREA} = \frac{5.9}{2.8} = 2.11$

AVG. $Q = 5.9 + \frac{2.11 \times 2.4}{2}$

$= 8.4$ CFS

AVG. SLOPE = 0.0725 = S

~~STREET SECTION~~



$A = 1.32$ SF $\quad P = 11.73' \quad n = .015$

$Q = AR^{2/3} \cdot 1.486/n\ (S^{1/2})$

$= 8.2$ CLOSE ENOUGH

$V = Q/A = 8.4/1.32 = 6.4$ FT/SEC

$T_t = \frac{385}{(6.4)(60)} = 1.0$ MIN.

10-Y

#26 F_M, INT., Q

~~F_M (AVG)~~ :

$A_1 = 2.8 \qquad F_{M_1} = 0.13$

$A_2 = 2.4 \qquad F_{M_2} = 0.15$

$\overline{5.2}$

$F_{M(AVG)} = \frac{2.8}{5.2} \times 0.13 + \frac{2.4}{5.2} \times 0.15$

$= 0.070 + 0.069 = \underline{0.14}$

$I = 10.209(12.9)^{-0.573}$

$I = 2.36$

$Q = 0.90(2.36 - 0.14)\,5.2$

$= 10.4$

(Q1)

10-Y

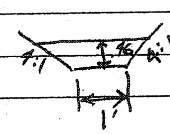
#20 Velocity, Intensity, T_t

$Q = 10.4$

$S_{AVG} = 0.1278$

$n = 0.030$

$b = 1.0'$



$Q = (K'/n)\,b^{8/3} S^{1/2}$

$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}} = 0.873$

$D/b = 0.48 \longrightarrow D = 0.48'$

$A = 1.40$ SF $\quad V = Q/A = \frac{10.4}{1.40} = 7.4$

$T_T = \frac{485}{(7.4)(60)} = 1.1$

$I = 10.209(14.0)^{-0.573}$

$I = 2.25$

10-Y

CONFLUENCE @ #20

$Q_2 = 21.9$	$Q_1 = 10.4$
$T_2 = 21.3$	$T_1 = 14.0$
$I_2 = 1.77$	$I_1 = 2.25$
$F_{m_2} = 0.25$	$F_{m_1} = 0.14$
$A_2 = 16.0$	$A_1 = 5.2$

$T_2 > T_1$ USE CASE 2A

$$Q_p = Q_2 + \left(\frac{I_2 - F_{m_1}}{I_1 - F_{m_1}}\right) Q_1$$

$$Q_p = 21.9 + \left(\frac{1.77 - 0.14}{2.25 - 0.14}\right) 10.4$$

$$Q_p = 29.9$$

10-Y

#32 Intensity

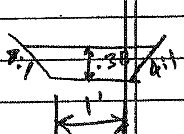
$$I = 10.209\,(16.7)^{-0.573}$$

$$I = 2.03$$

#34 Velocity, T_t

UPSTR. $Q/\text{AREA} = \frac{5.5}{3.4} = 1.62$

AVG $Q = 5.5 + \frac{0.5 \times 1.62}{2} = 5.9$



$$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}} \qquad S = .1091 \quad b = 1.0' \quad n = .030$$

$K' = 0.536$

$D/b = 0.38 \longrightarrow D = 0.38'$

$A = 0.96$ SF $\quad V = \frac{Q}{A} = 6.1$

$T_t = \frac{165}{(6.1)(60)} = 0.5$ MIN.

10-Y

#30 INTENSITY, Q

$$I = 10.209\,(16.5)^{-0.573}$$

$$I = 2.05$$

$$Q = 0.90\,(2.05 - 0.25)\,3.4$$

$$Q = 5.5$$

#32 velocity

18" PIPE FLOW K=105

$S = 0.1333$

$\longrightarrow$ USE KING'S TABLE 7-14 & 7-4

$$K' = \left(\frac{.463}{K}\right)\frac{Q}{S^{1/2}} = .0664$$

$D/d = 0.26 \longrightarrow C_a = 0.1623$

$A = C_a\, d^2 = (0.1623)(1.5)^2$

$A = 0.365$

$V = Q/A = 5.5/0.365 = 15.1$

$T_t = \frac{210}{(15.1)(60)} = 0.2$ MIN.

(Q1)

10-Y

#34 Intensity, Q

$$I = 10.209\,(17.2)^{-0.573}$$

$$I = 2.00$$

$$Q = 0.90\,(2.00 - 0.25)\,3.9$$

$$Q_1 = 6.1$$

10-Y

#37 INTENSITY, Q

$I = 10.209\,(13.1)^{-0.573}$

$I = 2.34$

$Q = 0.90\,(2.34 - 0.25)\,1.7$

$Q = 3.2$

#38 Velocity, T_t

$Q = 3.2$ 18" PIPE $K = 105$

AVG. $S_{PIPE} = 0.140$

USE KING'S TABLE 7-14 & 7-4

$K' = \left(\frac{.463}{K}\right)\frac{Q}{S^{1/2}} = 0.0377$

$D/d = 0.19 \longrightarrow C_a = 0.1039$

$A = C_a d^2 = 0.234$

$V = Q/A = 3.2/.234 = 13.7$

$T_t = \frac{150}{(13.7)(60)} = 0.2$ MIN.

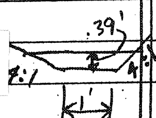
10-Y

#34 Velocity, T_t

UPSTREAM $Q/AREA = \frac{4.7}{2.5} = 1.88$

AVG $Q = 4.7 + \frac{3.0 \times 1.88}{2} = 7.5$

$K' = \frac{Q_n}{b^{8/3} \cdot S^{1/2}}$



$b = 1'$ $S = 0.1613$ $n = .030$

$K' = 0.560$

$D/b = 0.39 \longrightarrow D = 0.39'$

$A = 1.00$ SF $V = \frac{Q}{A} = 7.5$

$T_t = \frac{155}{(7.5)(60)} = 0.3$

10-Y

#38 F_M, INT., Q

F_M (AVG.):

$A_1 = 1.7$ $F_{M_1} = 0.25$

$A_2 = 0.8$ $F_{M_2} = 0.22$

2.5

$F_M\,(AVG) = \frac{1.7}{2.5} \times 0.25 + \frac{0.8}{2.5} \times 0.22$

$= 0.17 + 0.07 = \underline{0.24}$

$I = 10.209\,(13.3)^{-0.573}$

$I = 2.32$

$Q = 0.90\,(2.32 - 0.24)\,2.5$

$Q = 4.7$

10-Y

(Q_2)

#34 F_M, INT., Q

F_M (AVG):

$A_1 = 1.7$ $F_{M_1} = 0.25$

$A_2 = 0.8$ $F_{M_2} = 0.22$

$A_3 = 3.0$ $F_{M_3} = 0.25$

5.5

$F_M\,(AVG) = \frac{1.7}{5.5} \times 0.25 + \frac{0.8}{5.5} \times 0.22 + \frac{3.0}{5.5} \times 0.25$

$F_M\,(AVG) = 0.077 + 0.032 + 0.136$

$= 0.245$ SAY 0.25

$I = 10.209\,(13.6)^{-0.573}$

$I = 2.29$

$Q = 0.90\,(2.29 - 0.25)\,5.5$

$Q = 10.1$

10 - Y

34 CONFLUENCE

$Q_2 = 10.1$ $\quad Q_1 = 6.1$

$T_2 = 13.6$ $\quad T_1 = 17.2$

$I_2 = 2.29$ $\quad I_1 = 2.00$

$F_{M_2} = 0.25$ $\quad F_{M_1} = 0.25$

$A_2 = 5.5$ $\quad A_1 = 3.9$

$T_1 > T_2$ USE CASE 2B

$$Q_p = Q_2 + \left(\frac{I_2 - F_{M_1}}{I_1 - F_{M_1}}\right)\left(\frac{T_2}{T_1}\right) Q_1$$

$$Q_p = 10.1 + \left(\frac{2.29 - 0.25}{2.00 - 0.25}\right)\left(\frac{13.6}{17.2}\right) 6.1$$

$Q_p = 15.7$

10 - Y

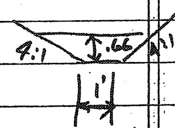
40 Velocity, T_t, INT, Q

UPSTREAM $Q/AREA = \frac{15.7}{9.4} = 1.67$

$AVG\ Q = 15.7 + \frac{4.5 \times 1.67}{2} = 19.5$

AVG. Slope $= 0.100$ $\quad n = .030$ $\quad b = 1.0'$

$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}} = 1.850$



$D/b = 0.66$ $\quad D = 0.66'$

$A = 2.40$ $\quad V = \frac{Q}{A} = 8.1$

$T_t = \frac{260}{(8.1)(60)} = 0.5$

$I = 10.209\,(14.1)^{-0.573}$

$I = 2.24$

$Q = 0.90\,(2.24 - 0.25)\,13.9$

$Q = 24.9$

10 - Y

45 INTENSITY, Q

$I = 10.209\,(12.2)^{-0.573}$

$I = 2.44$

$Q = 0.90\,(2.44 - 0.12)\,1.3$

$Q = 2.7$

10 - Y

45 SPLIT FLOWS

C.B. @ # 45 WILL PICKUP 2.4 cfs and 0.3 cfs will flow to # 56

Prorate areas as follows:

$A_{TOTAL} = 1.3$ $\quad Q_{TOTAL} = 2.7$

$Q_{45} = 2.4$ $\quad Q_{56} = 0.3$

$A_{45} = 1.2$ $\quad A_{56} = 0.1$

$F_{M_{45}} = 0.12$ $\quad F_{M_{56}} = 0.12$

$Tc_{45} = 12.2$ $\quad Tc_{56} = 12.2$

(Q_3)

10 - Y

#50 Velocity, T_t, INT,

$Q_3 = 2.4$ $L = 680'$

$S_{AVG.} = 0.1956$ $b = 1.0'$ $n = .030$

$$Q = \frac{K'}{n} \times b^{8/3}\, S^{1/2}$$

$$K' = \frac{Qn}{b^{8/3}\, S^{1/2}} = 0.163$$

$D/b = 0.22 \rightarrow D = 0.22'$

$A = 0.41$ S.F.

$$V = \frac{Q}{A} = \frac{2.4}{0.41} = 5.9\ \frac{FT}{SEC}$$

$$T_t = \frac{680}{(5.9)(60)} = 1.9 \text{ MIN.}$$

$I = 10.209(14.1)^{-0.573}$

$I = 2.24$

(Q_2, Q_1)

10 - Y

#50 Intensity, Q

$I_2 = 10.209\,(19.3)^{-0.573}$

$I_2 = 1.87$

$Q_2 = 0.90\,(1.87 - 0.25)\,7.0$

$Q_2 = 10.2$

$I_1 = 10.209\,(18.4)^{-0.573}$

$I_1 = 1.92$

$Q_1 = 0.90\,(1.92 - 0.25)\,2.8$

$Q_1 = 4.2$

10 - Y CONFLUENCE

@ #50

$T_2 > T_1 > T_3$

USE CASE 2A

$T_2 = 19.3$	$T_1 = 18.4$	$T_3 = 14.1$
$I_2 = 1.87$	$I_1 = 1.92$	$I_3 = 2.24$
$F_{M2} = 0.25$	$F_{M1} = 0.25$	$F_{M3} = 0.12$
$A_2 = 7.0$	$A_1 = 2.8$	$A_3 = 1.2$
$Q_2 = 10.2$	$Q_1 = 4.2$	$Q_3 = 2.4$

$$Q_p = Q_2 + \left[\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right] Q_1 + \left[\frac{I_2 - F_{M3}}{I_3 - F_{M3}}\right] Q_3$$

$Q_p = 10.2 + 4.1 + 2.0$

$Q = 16.3$

10 - Y

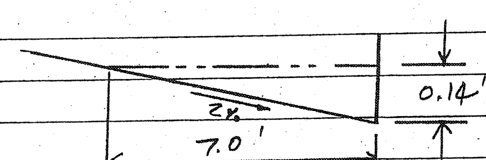
#56 VELOCITY, T_t

upstream $Q/AREA = \frac{2.7}{1.3} = 2.08$

$$Q_{AVG} = 0.3 + \frac{2.08 \times 2.4}{2} = 2.8$$

AVG. SLOPE = 0.0997

STREET SECTION



~~A = 0.49 SF   P = 7.14'   n = 0.015~~

~~$Q = AR^{2/3} \cdot 1.486/n\ (S^{1/2})$~~

$= 2.6$ CLOSE ENOUGH

$$V = Q/A = \frac{2.8}{0.49} = 5.7 \text{ FT/SEC}$$

$$T_t = \frac{1{,}170}{(5.7)(60)} = 3.4 \text{ MIN.}$$

10-Y

#56 F_M, INT, Q

~~F_M (AVG) =~~

$A_1 = 0.1$ $\quad F_{M1} = 0.12$

$A_2 = \underline{2.4}$ $\quad F_{M2} = 0.17$

2.5

$F_M(AVG) = \frac{0.1}{2.5} \times 0.12 + \frac{2.4}{2.5} \times 0.17$

$F_M(AVG) = 0.005 + 0.163$

$F_M(AVG) = 0.168$ SAY $\underline{0.17}$

$I = 10.209\,(15.6)^{-0.573}$

$I = 2.12$

$Q = 0.90\,(2.12 - 0.17)\,2.5$

$Q = 4.4$

10 – Y

#70 F_M, INT, Q

~~F_M(AVG) =~~

$A_1 = 2.5$ $\quad F_{M1} = 0.17$

$A_2 = \underline{1.4}$ $\quad F_{M2} = 0.23$

3.9

$F_M(AVG) = \frac{2.5}{3.9} \times 0.17 + \frac{1.4}{3.9} \times 0.23$

$F_M(AVG) = 0.109 + 0.083$

$F_M(AVG) = 0.192$ SAY $\underline{0.19}$

$I = 10.209\,(16.5)^{-0.573}$

$I = 2.05$

$Q = 0.90\,(2.05 - 0.19)\,3.9$

$Q = 6.5$

10 – Y

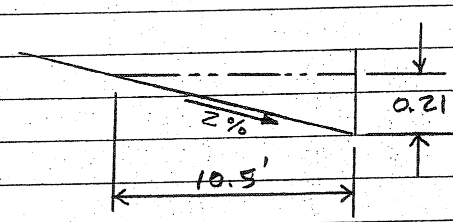
#70 Velocity, T_t

UPSTREAM $Q/\text{AREA} = \frac{4.4}{2.5} = 1.76$

$Q_{AVG} = 4.4 + \frac{1.4 \times 1.76}{2} = 5.6$

AVG. SLOPE = 0.0597

STREET SECTION



$A = 1.10$ SF, $P = 10.71'$, $n = 0.015$

$Q = AR^{2/3} \cdot 1.486/n \,(S^{1/2})$

$= 5.8$ CLOSE ENOUGH

$V = \frac{Q}{A} = \frac{5.6}{1.10} = 5.1$ FT/SEC

$T_t = \frac{285}{(5.1)(60)} = 0.9$ MIN.

10 – Y

#65 INTENSITY, Q

$I = 10.209\,(7.5)^{-0.573}$

$I = 3.22$

$Q = 0.90\,(3.22 - 0.18)\,0.7$

$Q = 1.9$

10 – Y

#80 INTENSITY, Q

$I = 10.209\,(16.9)^{-0.573}$

$I = 2.02$

$Q = 0.90\,(2.02 - 0.25)\,3.8$

$Q = 6.1$

100 Y

10 INTENSITY & Q

$I_{(t)} = a t^{b}$

$I_2 = 15.56\,(20.4)^{-0.573}$

$I_2 = 2.76$

$Q_2 = 0.90(I - F_m)\,A$

$Q_2 = 0.90(2.76 - 0.25)\,6.3$

$Q_2 = 14.2$

$I_1 = 15.56\,(19.8)^{-0.573}$

$I_1 = 2.81$

$Q_1 = 0.90\,(2.81 - 0.25)\,5.8$

$Q_1 = 13.4$

100-Y

(Q2)

20 Velocity & Depth of Flow

$\frac{14.2}{6.3} = 2.25$ $\frac{13.4}{5.8} = 2.31$ AVG. = 2.28

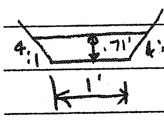
AVG. $Q = \frac{2.28 \times 3.9}{2} + 27.3 = 31.7$

~~AVG. SLOPE = 0.0747~~

$Q = K'/n\, b^{8/3} S^{1/2}$

$Q = 31.7$, $n = .030$, $b = 1'$, $S = 0.0747$

$K' = \frac{Q\,n}{b^{8/3} S^{1/2}} = 3.48$



$D/b = 0.86 \longrightarrow D = 0.86'$

$A = 3.82$

$V = Q/A = 31.7/3.82 = 8.3$ FT/SEC.

$T_t = \frac{L}{(V)(60)} = \frac{375}{(8.3)(60)} = 0.8$

100-Y CONFLUENCE

$T_2 > T_1$ @ # 10

USE CASE 2A

$T_2 = 20.4$	$T_1 = 19.8$
$I_2 = 2.76$	$I_1 = 2.81$
$F_{M_2} = 0.25$	$F_{M_1} = 0.25$
$A_2 = 6.3$	$A_1 = 5.8$
$Q_2 = 14.2$	$Q_1 = 13.4$

$Q_P = Q_2 + \left(\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right) Q_1$

$Q_P = 14.2 + \left(\frac{2.76 - 0.25}{2.81 - 0.25}\right) 13.4$

$Q_P = 27.3$

100-Y

(Q2)

20 INTENSITY & Q

$T_{c_2} = 21.2$

$I_2 = 15.56\,(21.2)^{-0.573}$

$I_2 = 2.70$

$Q_2 = 0.90\,(2.70 - 0.25)\,16.0$

$Q_2 = 35.3$

100-Y

#24 INTENSITY & Q

$I = 15.56\,(11.9)^{-0.573}$

$I = 3.76$

$Q = 0.90\,(3.76 - 0.13)\,2.8$

$= 9.1$

100-Y

#26 Velocity

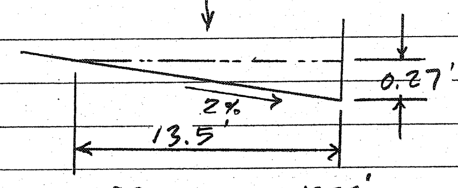
UPSTREAM $Q/_{AREA} = \frac{9.1}{2.8} = 3.25$

AVG. $Q = 9.1 + \frac{3.25 \times 2.4}{2}$

$= 13.0$ CFS

AVG. SLOPE $= 0.0725 = S$

STREET SECTION



$A = 1.82$ SF $\quad P = 13.77' \quad n = .015$

$Q = AR^{2/3} \cdot 1.486/n\,(S^{1/2})$

$= 12.6$ CLOSE ENOUGH

$V = Q/A = 13.0/1.82 = 7.1$ FT/SEC

$T_t = \frac{385}{(7.1)(60)} = 0.9$ MIN.

100-Y

#26 F_M, INT., Q

~~F_M (AVG)~~ :

$A_1 = 2.8 \qquad F_{M_1} = 0.13$

$A_2 = 2.4 \qquad F_{M_2} = 0.15$

$\underline{}$ 5.2

$F_{M(AVG)} = \frac{2.8}{5.2} \times 0.13 + \frac{2.4}{5.2} \times 0.15$

$= 0.070 + 0.069 = \underline{0.14}$

$I = 15.56\,(12.8)^{-0.573}$

$I = 3.61$

$Q = 0.90\,(3.61 - 0.14)\,5.2$

$= 16.2$

(Q1)

100-Y

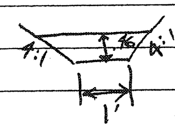
#20 Velocity, Intensity, T_t

$Q = 16.2$

$S_{AVG} = 0.1278$

$n = 0.030$

$b = 1.0'$



$Q = (K'/n)\,b^{8/3}\,S^{1/2}$

$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}} = 1.36$

$D/b = 0.58 \longrightarrow D = 0.58'$

$A = 1.93$ SF $\quad V = Q/A = \frac{16.2}{1.93} = 8.4$

$T_T = \frac{485}{(8.4)(60)} = 1.0$ MIN.

$I = 15.56\,(13.8)^{-0.573}$

$I = 3.46$

100-Y

CONFLUENCE @ #20

$Q_2 = 35.3$ $\quad Q_1 = 16.2$

$T_2 = 21.2$ $\quad T_1 = 13.8$

$I_2 = 2.70$ $\quad I_1 = 3.46$

$F_{M_2} = 0.25$ $\quad F_{M_1} = 0.14$

$A_2 = 16.0$ $\quad A_1 = 5.2$

~~$T_2 > T_1$ USE CASE 2A~~

$$Q_p = Q_2 + \left(\frac{I_2 - F_{M_1}}{I_1 - F_{M_1}}\right) Q_1$$

$$Q_p = 35.3 + \left(\frac{2.70 - 0.14}{3.46 - 0.14}\right) 16.2$$

$$Q_p = 47.8$$

100-Y

#30 INTENSITY, Q

$I = 15.56\,(16.5)^{-0.573}$

$I = 3.12$

$Q = 0.90(3.12 - 0.25)\,3.4$

$Q = 8.8$

#32 velocity

~~18" PIPE FLOW K=105~~

$S = 0.1333$ $\quad$ ~~$Q = 8.8$~~

→ USE KING'S TABLE 7-14 & 7-4

$K' = \left(\frac{.463}{K}\right) \frac{Q}{S^{1/2}} = 0.1062$

$D/d = 0.33 \longrightarrow C_a = 0.2260$

$A = C_a\, d^2 = (0.2260)(1.5)^2$

$A = 0.509$

$V = Q/A = 8.8/0.509 = 17.3$

$T_t = \frac{210}{(17.3)(60)} = 0.2$ MIN.

100-Y

#32 Intensity

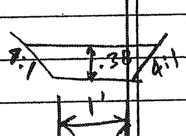
$I = 15.56\,(16.7)^{-0.573}$

$I = 3.10$

#34 Velocity, T_t

UPSTR. $Q/\text{AREA} = \frac{8.8}{3.4} = 2.59$

~~AVG $Q = 8.8 + \frac{0.5 \times 2.59}{2} = 9.4$~~



$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}}$ $\quad S = .1091$ $\quad b = 1.0'$ $n = .030$

$K' = 0.853$

$D/b = 0.47 \longrightarrow D = 0.47'$

$A = 1.35$ SF $\quad V = \frac{Q}{A} = 7.0$

$T_t = \frac{165}{(7.0)(60)} = 0.4$ MIN.

100-Y

(Q_1)

#34 Intensity, Q

$I = 15.56\,(17.1)^{-0.573}$

$I = 3.06$

$Q = 0.90(3.06 - 0.25)\,3.9$

$Q_1 = 9.9$

100 - Y

37 INTENSITY, Q

$I = 15.56\,(13.1)^{-0.573}$

$I = 3.56$

$Q = 0.90(3.56 - 0.25)\,1.7$

$Q = 5.1$

38 Velocity, T_t

$Q = 5.1$ 18" PIPE $K = 105$

AVG. $S_{PIPE} = 0.140$

USE KING'S TABLE 7-14 & 7-4

$K' = \left(\frac{.463}{K}\right)\frac{Q}{S^{1/2}} = 0.0601$

$D/d = 0.24 \longrightarrow C_a = 0.1449$

$A = C_a d^2 = 0.33$

$V = Q/A = 5.1/0.33 = 15.5$

$T_t = \frac{150}{(15.5)(60)} = 0.2$ MIN.

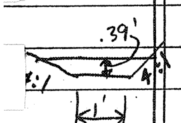
100 - Y

34 Velocity, T_t

UPSTREAM $Q/\text{AREA} = \frac{7.4}{2.5} = 2.96$

AVG $Q = 7.4 + \frac{3.0 \times 2.96}{2} = 11.8$

$K' = \frac{Q_n}{b^{8/3} \cdot S^{1/2}}$



$b = 1'$ $S = 0.1613$ $n = .030$

$K' = 0.881$

$D/b = 0.48 \longrightarrow D = 0.48'$

$A = 1.40$ SF $V = \frac{Q}{A} = 8.4$

$T_t = \frac{155}{(8.4)(60)} = 0.3$ MIN.

100 - Y

38 F_M, INT., Q

F_M (AVG.):

$A_1 = 1.7$ $F_{M_1} = 0.25$

$A_2 = 0.8$ $F_{M_2} = 0.22$

2.5

$F_M(\text{AVG}) = \frac{1.7}{2.5} \times 0.25 + \frac{0.8}{2.5} \times 0.22$

$= 0.17 + 0.07 = \underline{0.24}$

$I = 15.56\,(13.3)^{-0.573}$

$I = 3.53$

$Q = 0.90\,(3.53 - 0.24)\,2.5$

$Q = 7.4$

100 - Y

(Q2)

34 F_M, INT., Q

F_M (AVG):

$A_1 = 1.7$ $F_{M_1} = 0.25$

$A_2 = 0.8$ $F_{M_2} = 0.22$

$A_3 = 3.0$ $F_{M_3} = 0.25$

5.5

$F_M(\text{AVG}) = \frac{1.7}{5.5} \times 0.25 + \frac{0.8}{5.5} \times 0.22 + \frac{3.0}{5.5} \times 0.25$

$F_M(\text{AVG}) = 0.077 + 0.032 + 0.136$

$= 0.245$ SAY 0.25

$I = 15.56\,(13.6)^{-0.573}$

$I = 3.49$

$Q = 0.90\,(3.49 - 0.25)\,5.5$

$Q = 16.0$

100-Y

#34 CONFLUENCE

$Q_2 = 16.0$ $Q_1 = 9.9$

$T_2 = 13.6$ $T_1 = 17.1$

$I_2 = 3.49$ $I_1 = 3.06$

$F_{M_2} = 0.25$ $F_{M_1} = 0.25$

$A_2 = 5.5$ $A_1 = 3.9$

$T_1 > T_2$ USE CASE 2B

$$Q_p = Q_2 + \left(\frac{I_2 - F_{M_1}}{I_1 - F_{M_1}}\right)\left(\frac{T_2}{T_1}\right) Q_1$$

$$Q_p = 16.0 + \left(\frac{3.49 - 0.25}{3.06 - 0.25}\right)\left(\frac{13.6}{17.1}\right) 9.9$$

$Q_p = 25.1$

100-Y

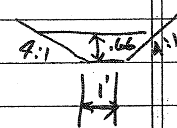
#40 Velocity, T_t, INT, Q

~~UPSTREAM~~ $Q/\text{AREA} = \frac{25.1}{9.4} = 2.67$

$\text{AVG } Q = 25.1 + \frac{4.5 \times 2.67}{2} = 31.1$

AVG. Slope = 0.100 $n = .030$ $b = 1.0'$

$K' = \frac{Qn}{b^{8/3} \cdot S^{1/2}} = 2.95$



$D/b = 0.81$ $D = 0.81'$

$A = 3.43$ $V = \frac{Q}{A} = 9.1$

$T_t = \frac{260}{(9.1)(60)} = 0.5$

$I = 15.56(14.1)^{-0.573}$

$I = 3.42$

$Q = 0.90(3.42 - 0.25)\ 13.9$

$Q = 39.7$

100-Y

#45 INTENSITY, Q

$I = 15.56\ (12.2)^{-0.573}$

$I = 3.71$

$Q = 0.90\ (3.71 - 0.12)\ 1.3$

$Q = 4.0$

100-Y

#45 SPLIT FLOWS

C.B. @ #45 WILL PICKUP 3.0 cfs and 1.0 cfs will flow to #56

Prorate areas as follows:

$A_{TOTAL} = 1.3$ $Q_{TOTAL} = 4.0$

$Q_{45} = 3.0$ $Q_{56} = 1.0$

$A_{45} = 1.0$ $A_{56} = 0.3$

$F_{M_{45}} = 0.12$ $F_{M_{56}} = 0.12$

$T_{c_{45}} = 12.2$ $T_{c_{56}} = 12.2$

100 - Y

(Q3) #50 Velocity, T_t, INT.

$Q_3 = 3.0$ $L = 680'$

$S_{AVG.} = 0.1956$ $b = 1.0'$ $n = .030$

$Q = \frac{K'}{n} \times b^{8/3} S^{1/2}$

$K' = \frac{Qn}{b^{8/3} S^{1/2}} = 0.204$

$D/b = 0.24 \rightarrow D = 0.24'$

$A = 0.47$ S.F.

$V = \frac{Q}{A} = \frac{3.0}{0.47} = 6.4 \frac{FT}{SEC}$

$T_t = \frac{680}{(6.4)(60)} = 1.8$ MIN.

$I = 15.56(14.0)^{-0.573}$

$I = 3.43$

100 - Y

(Q2, Q1) #50 Intensity, Q

$I_2 = 15.56 (19.3)^{-0.573}$

$I_2 = 2.85$

$Q_2 = 0.90(2.85 - 0.25)\,7.0$

$Q_2 = 16.4$

$I_1 = 15.56(18.4)^{-0.573}$

$I_1 = 2.93$

$Q_1 = 0.90(2.93 - 0.25)\,2.8$

$Q_1 = 6.8$

100 - Y CONFLUENCE @ #50

$T_2 > T_1 > T_3$

USE CASE 2A

$T_2 = 19.3$	$T_1 = 18.4$	$T_3 = 14.0$
$I_2 = 2.85$	$I_1 = 2.93$	$I_3 = 3.43$
$F_{M2} = 0.25$	$F_{M1} = 0.25$	$F_{M3} = 0.12$
$A_2 = 7.0$	$A_1 = 2.8$	$A_3 = 1.0$
$Q_2 = 16.4$	$Q_1 = 6.8$	$Q_3 = 3.0$

$Q_p = Q_2 + \left[\frac{I_2 - F_{M1}}{I_1 - F_{M1}}\right] Q_1 + \left[\frac{I_2 - F_{M3}}{I_3 - F_{M3}}\right] Q_3$

$Q_p = 16.4 + 6.6 + 2.5$

$Q_p = 25.5$

100 - Y

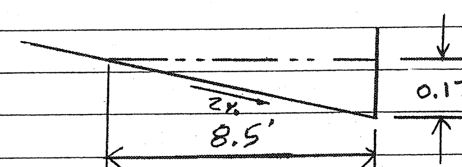
#56 VELOCITY, T_t

upstream $Q/AREA = \frac{4.0}{1.3} = 3.08$

$Q_{AVG} = 1.0 + \frac{3.08 \times 2.4}{2} = 4.7$

AVG. SLOPE = 0.0997

STREET SECTION



$A = 0.72$ SF $P = 8.67$ $n = 0.015$

$Q = AR^{2/3} \cdot 1.486/n\,(S^{1/2})$

$= 4.3$ CLOSE ENOUGH

$V = Q/A = 4.7/0.72 = 6.5$ FT/SEC

$T_t = \frac{1,170}{(6.5)(60)} = 3.0$ MIN.

100-Y

#56 F_M, INT, Q

~~F_M (AVG) =~~

$A_1 = 0.3$ $F_{M_1} = 0.12$

$A_2 = 2.4$ $F_{M_2} = 0.17$

2.2

~~$F_M(AVG) = \frac{0.3}{2.7} \times 0.12 + \frac{2.4}{2.7} \times 0.17$~~

$F_M (AVG) = 0.013 + 0.151$

$F_M (AVG) = 0.164$ SAY 0.16

$I = 15.56\,(15.2)^{-0.573}$

$I = 3.27$

$Q = 0.90\,(3.27 - 0.16)\,2.7$

$Q = 7.6$

100 - Y

#70 F_M, INT, Q

~~F_M (AVG) =~~

$A_1 = 2.7$ $F_{M_1} = 0.16$

$A_2 = 1.4$ $F_{M_2} = 0.23$

4.1

~~$F_M(AVG) = \frac{2.7}{4.1} \times 0.16 + \frac{1.4}{4.1} \times 0.23$~~

$F_M (AVG) = 0.105 + 0.079$

$F_M (AVG) = 0.184$ SAY 0.18

$I = 15.56\,(16.0)^{-0.573}$

$I = 3.18$

$Q = 0.90\,(3.18 - 0.18)\,4.1$

$Q = 11.1$

100 - Y

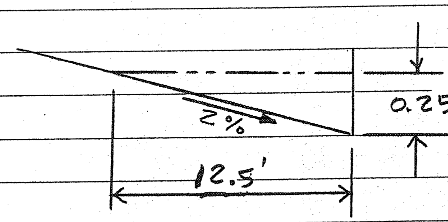
#70 Velocity, T_t

UPSTREAM Q/AREA $= \frac{7.6}{2.7} = 2.81$

$Q_{AVG} = 7.6 + \frac{1.4 \times 2.81}{2} = 9.6$

AVG. SLOPE = 0.0597

STREET SECTION



A = 1.56 SF, P = 12.75, n = 0.015

$Q = AR^{2/3} \cdot 1.486/n\,(S^{1/2})$

$= 9.3$ CLOSE ENOUGH

$V = \frac{Q}{A} = \frac{9.6}{1.56} = 6.2$ FT/SEC

$T_t = \frac{285}{(6.2)(60)} = 0.8$ MIN.

100 - Y

#65 INTENSITY, Q

$I = 15.56\,(7.5)^{-0.573}$

$I = 4.90$

$Q = 0.90\,(4.90 - 0.18)\,0.7$

$Q = 3.0$

100 - Y

#80 INTENSITY, Q

$I = 15.56\,(16.9)^{-0.573}$

$I = 3.08$

$Q = 0.90\,(3.08\;\;0.25)\,3.8$

$Q = 9.7$

Table 7-11. Values of K' in Formula $Q = \dfrac{K'}{n} b^{8/3} s^{1/2}$ for Trapezoidal Channels

D = depth of water b = bottom width of channel

$\frac{D}{b}$	Side slopes of channel, ratio of horizontal to vertical									
	Vertical	¼–1	½–1	¾–1	1–1	1½–1	2–1	2½–1	3–1	4–1
.01	.00068	.00068	.00069	.00069	.00069	.00069	.00069	.00069	.00070	.00070
.02	.00213	.00215	.00216	.00217	.00218	.00220	.00221	.00222	.00223	.00225
.03	.00414	.00419	.00423	.00426	.00428	.00433	.00436	.00439	.00443	.00449
.04	.00660	.00670	.00679	.00685	.00691	.00700	.00708	.00716	.00723	.00736
.05	.00946	.00964	.00979	.00991	.01002	.01019	.01033	.01047	.01060	.01086
.06	.0127	.0130	.0132	.0134	.0136	.0138	.0141	.0143	.0145	.0150
.07	.0162	.0166	.0170	.0173	.0175	.0180	.0183	.0187	.0190	.0197
.08	.0200	.0206	.0211	.0215	.0219	.0225	.0231	.0236	.0240	.0250
.09	.0241	.0249	.0256	.0262	.0267	.0275	.0282	.0289	.0296	.0310
.10	.0284	.0294	.0304	.0311	.0318	.0329	.0339	.0348	.0358	.0376
.11	.0329	.0343	.0354	.0364	.0373	.0387	.0400	.0413	.0424	.0448
.12	.0376	.0393	.0408	.0420	.0431	.0450	.0466	.0482	.0497	.0527
.13	.0425	.0446	.0464	.0480	.0493	.0516	.0537	.0556	.0575	.0613
.14	.0476	.0502	.0524	.0542	.0559	.0587	.0612	.0636	.0659	.0706
.15	.0528	.0559	.0585	.0608	.0627	.0662	.0692	.0721	.0749	.0805
.16	.0582	.0619	.0650	.0676	.0700	.0740	.0777	.0811	.0845	.0912
.17	.0638	.0680	.0716	.0748	.0775	.0823	.0866	.0907	.0947	.1026
.18	.0695	.0744	.0786	.0822	.0854	.0910	.0960	.1008	.1055	.1148
.19	.0753	.0809	.0857	.0899	.0936	.1001	.1059	.1115	.1169	.1277
.20	.0812	.0876	.0931	.0979	.1021	.1096	.1163	.1227	.1290	.1414
.21	.0873	.0945	.101	.106	.111	.120	.127	.135	.142	.156
.22	.0934	.1015	.109	.115	.120	.130	.139	.147	.155	.171
.23	.0997	.1087	.117	.124	.130	.141	.150	.160	.169	.187
.24	.1061	.1161	.125	.133	.140	.152	.163	.173	.184	.204
.25	.1125	.1236	.133	.142	.150	.163	.176	.188	.199	.222
.26	.119	.131	.142	.152	.160	.175	.189	.202	.215	.241
.27	.126	.139	.151	.162	.171	.188	.203	.218	.232	.260
.28	.132	.147	.160	.172	.182	.201	.217	.234	.249	.281
.29	.139	.155	.170	.182	.194	.214	.232	.250	.268	.302
.30	.146	.163	.179	.193	.205	.228	.248	.267	.287	.324
.31	.153	.172	.189	.204	.218	.242	.264	.285	.306	.347
.32	.160	.180	.199	.215	.230	.256	.281	.304	.327	.371
.33	.167	.189	.209	.227	.243	.271	.298	.323	.348	.396
.34	.174	.198	.219	.238	.256	.287	.316	.343	.370	.423
.35	.181	.207	.230	.251	.269	.303	.334	.363	.392	.450
.36	.189	.216	.241	.263	.283	.319	.353	.385	.416	.478
.37	.196	.225	.252	.275	.297	.336	.372	.406	.440	.507
.38	.203	.234	.263	.288	.312	.353	.392	.429	.465	.537
.39	.211	.244	.274	.301	.326	.371	.413	.452	.491	.568
.40	.218	.253	.286	.315	.341	.389	.434	.476	.518	.600
.41	.226	.263	.297	.328	.357	.408	.456	.501	.546	.633
.42	.233	.273	.309	.342	.373	.427	.478	.526	.574	.668
.43	.241	.283	.321	.357	.389	.447	.501	.553	.603	.703
.44	.248	.293	.334	.371	.405	.467	.525	.580	.633	.740
.45	.256	.303	.346	.386	.422	.488	.549	.607	.664	.777

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Table 7-11. Values of K' in Formula $Q = \frac{K'}{n} b^{8/3} s^{1/2}$ for Trapezoidal Channels (*Continued*)

D = depth of water b = bottom width of channel

$\frac{D}{b}$	Side slopes of channel, ratio of horizontal to vertical									
	Vertical	¼–1	½–1	¾–1	1–1	1½–1	2–1	2½–1	3–1	4–1
.46	.264	.313	.359	.401	.439	.509	.574	.636	.696	.816
.47	.271	.323	.372	.416	.457	.531	.599	.665	.729	.856
.48	.279	.334	.385	.432	.474	.553	.625	.695	.763	.897
.49	.287	.344	.398	.447	.493	.575	.652	.725	.797	.939
.50	.295	.355	.412	.463	.511	.598	.679	.757	.833	.983
.51	.303	.366	.425	.480	.530	.622	.707	.789	.869	1.03
.52	.311	.377	.439	.496	.549	.646	.736	.822	.907	1.07
.53	.319	.388	.453	.513	.569	.671	.765	.856	.945	1.12
.54	.327	.399	.467	.531	.589	.696	.795	.891	.984	1.17
.55	.335	.410	.482	.548	.609	.722	.826	.926	1.025	1.22
.56	.343	.422	.497	.566	.630	.748	.857	.963	1.07	1.27
.57	.351	.433	.511	.584	.651	.775	.889	1.000	1.11	1.32
.58	.359	.445	.526	.602	.673	.802	.922	1.038	1.15	1.37
.59	.367	.456	.542	.621	.694	.830	.956	1.077	1.20	1.43
.60	.375	.468	.557	.640	.717	.858	.990	1.117	1.24	1.49
.61	.383	.480	.573	.659	.739	.887	1.02	1.16	1.29	1.54
.62	.391	.492	.588	.678	.762	.916	1.06	1.20	1.33	1.60
.63	.399	.504	.604	.698	.785	.946	1.10	1.24	1.38	1.66
.64	.408	.516	.620	.718	.809	.977	1.13	1.28	1.43	1.72
.65	.416	.529	.637	.738	.833	1.008	1.17	1.33	1.48	1.79
.66	.424	.541	.653	.759	.857	1.04	1.21	1.37	1.53	1.85
.67	.433	.553	.670	.780	.882	1.07	1.25	1.42	1.59	1.91
.68	.441	.566	.687	.801	.907	1.10	1.29	1.47	1.64	1.98
.69	.449	.579	.704	.822	.933	1.14	1.33	1.51	1.69	2.05
.70	.457	.592	.722	.844	.959	1.17	1.37	1.56	1.75	2.12
.71	.466	.604	.739	.866	.985	1.21	1.41	1.61	1.81	2.19
.72	.474	.617	.757	.889	1.012	1.24	1.46	1.66	1.86	2.26
.73	.483	.631	.775	.911	1.039	1.28	1.50	1.71	1.92	2.34
.74	.491	.644	.793	.934	1.067	1.31	1.54	1.77	1.98	2.41
.75	.499	.657	.811	.957	1.095	1.35	1.59	1.82	2.05	2.49
.76	.508	.670	.830	.981	1.12	1.39	1.63	1.87	2.11	2.57
.77	.516	.684	.849	1.005	1.15	1.43	1.68	1.93	2.17	2.65
.78	.525	.698	.868	1.029	1.18	1.46	1.73	1.99	2.24	2.73
.79	.533	.711	.887	1.053	1.21	1.50	1.78	2.04	2.30	2.81
.80	.542	.725	.906	1.078	1.24	1.54	1.83	2.10	2.37	2.90
.81	.550	.739	.925	1.10	1.27	1.58	1.88	2.16	2.44	2.98
.82	.559	.753	.945	1.13	1.30	1.62	1.93	2.22	2.51	3.07
.83	.567	.767	.965	1.15	1.33	1.67	1.98	2.28	2.58	3.16
.84	.576	.781	.985	1.18	1.36	1.71	2.03	2.34	2.65	3.25
.85	.585	.796	1.006	1.21	1.40	1.75	2.08	2.41	2.72	3.35
.86	.593	.810	1.03	1.23	1.43	1.79	2.14	2.47	2.80	3.44
.87	.602	.825	1.05	1.26	1.46	1.84	2.19	2.54	2.87	3.54
.88	.610	.839	1.07	1.29	1.49	1.88	2.25	2.60	2.95	3.63
.89	.619	.854	1.09	1.31	1.53	1.93	2.31	2.67	3.03	3.73
.90	.628	.869	1.11	1.34	1.56	1.98	2.36	2.74	3.11	3.83

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CATCH BASIN

CALCULATIONS

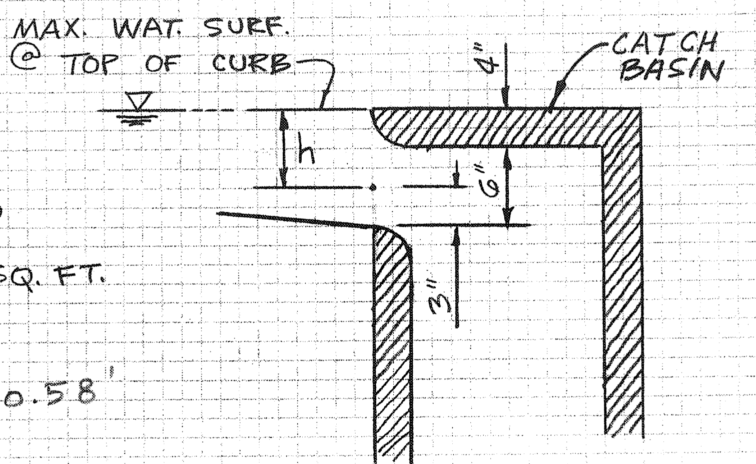
CSL ENGINEERING, INC.

CIVIL ENGINEERING • SURVEYING • LAND PLANNING

@ NODE 26 100-YEAR

CATCH BASIN DESIGN (SUMP CONDITION)

• USE ORIFICE FORMULA : $Q = C_a \cdot A \cdot \sqrt{2gh}$



Q = STORM FLOW, CFS

C_a = coefficient = 0.60

A = AREA OF OPENING, SQ. FT.

g = 32.2 FT/SEC/SEC

h = head, FT. = 7" = 0.58'

Q_{100} = 16.2 CFS

SPLIT FLOWS 50/50 TO EACH BASIN

$Q = \frac{16.2}{2} = 8.1 \text{ CFS} = C_a \cdot A \cdot \sqrt{2gh}$

$8.1 = (0.60)(0.5 \times W)\sqrt{64.4 \times 0.58}$

$W = 4.42'$

$\boxed{\text{USE } W = 7'}$

11651 Sterling Avenue, Suite E Riverside, CA 92503 (909) 785-5122 FAX (909) 785-5180

10 -YEAR

C.B. # NODE 45

CURB OPENING (Interception)

Given: (a) discharge Q_{10} = 2.7 CFS

(b) street slope S = 0.010 '/'

(c) curb type "A-2" "D" C.F. 6"

(d) half street width = 14' ft.

Solution:

$Q/S^{1/2}$ = 2.7 /(0.010)$^{1/2}$ = 27.00 Therefore y= $\boxed{0.33}$

Q /L = 0.32

L = 2.7 / 0.32 = 8.44 (L for total interception)

TRY: L_p= 7 ft.

L_p/L = 7 / 8.44 = $\boxed{0.83}$

a/y = .33/ .33 = $\boxed{1.00}$

Q_p/Q = 0.90

Q_p= 0.90 X 2.7 = 2.4 CFS (Intercepted)

Q_c= 2.7 - 2.4 = 0.3 CFS (Carryover)

USE W = 7'

C.B. #_NODE 45_

CURB OPENING (Interception)

Given: (a) discharge Q_{100} = 4.0 CFS

(b) street slope S = 0.010 '/'

(c) curb type "A-2" "D" C.F. 6"

(d) half street width = 14' ft.

Solution:

$Q/S^{1/2}$ = 4.0 /(0.010)$^{1/2}$ = 40.00 Therefore y= $\boxed{0.36}$

Q /L = 0.35

L = 4.0 / 0.35 = 11.43 (L for total interception)

TRY: L_p= 7 ft.

L_p/L = 7 / 11.43 = $\boxed{0.61}$

a/y = .33/ 0.36 = $\boxed{0.92}$

Q_p/Q = 0.75

Q_p= 0.75 X 4.0 = 3.0 CFS (Intercepted)

Q_c= 4.0 - 3.0 = 1.0 CFS (Carryover)

USE W = 7'

100-YEAR

C.B. # NODE 56 (EAST)

CURB OPENING (Interception)

PRORATE FLOWS BY AREA

$A_{TOTAL} = 2.7$ ACRES

$A_{EAST} = 1.8$ ACRES

$A_{WEST} = 0.9$ ACRES

$Q_{TOTAL} = 7.6$

$Q_{EAST} = \frac{1.8}{2.7} \times 7.6 = 5.1$ CFS

$Q_{WEST} = \frac{0.9}{2.7} \times 7.6 = 2.5$ CFS

Given:

(a) discharge Q_{100} = 5.1 CFS

(b) street slope S = 0.140 '/'

(c) curb type "A-2" "D" C.F. 6"

(d) half street width = 14 ft.

Solution:

$Q/S^{1/2}$ = 5.1 /(0.140)$^{1/2}$ = 13.63 Therefore y= $\boxed{0.27}$

Q /L = 0.26

L = 5.1 / 0.26 = 19.62 (L for total interception)

TRY: L_p= 21 ft.

L_p/L = ____/____ = $\boxed{}$

a/y = .33/____ = $\boxed{}$

Q_p/Q = ____

Q_p= ____ X ____ = ____ CFS (Intercepted)

Q_c= ____ - ____ = ____ CFS (Carryover)

USE W = 21'

100-YEAR

C.B. # NODE 56 (WEST)

CURB OPENING (Interception)

Given: (a) discharge Q_{100} = 2.5 CFS

(b) street slope S = 0.140 '/'

(c) curb type "A-2" "D" C.F. 6"

(d) half street width = 14 ft.

PRORATE FLOWS BY AREA

A_{TOTAL} = 2.7 ACRES

A_{EAST} = 1.8 ACRES

A_{WEST} = 0.9 ACRES

Q_{TOTAL} = 7.6

$Q_{EAST} = \frac{1.8}{2.7} \times 7.6 = 5.1$ CFS

$Q_{WEST} = \frac{0.9}{2.7} \times 7.6 = 2.5$ CFS

Solution:

$Q/S^{1/2}$ = 2.5 /(0.140)$^{1/2}$ = 6.68 Therefore y= $\boxed{0.22}$

Q /L = 0.21

L = 2.5 / 0.21 = 11.90 (L for total interception)

TRY: L_p= 14 ft.

L_p/L = ____ / ____ = ☐

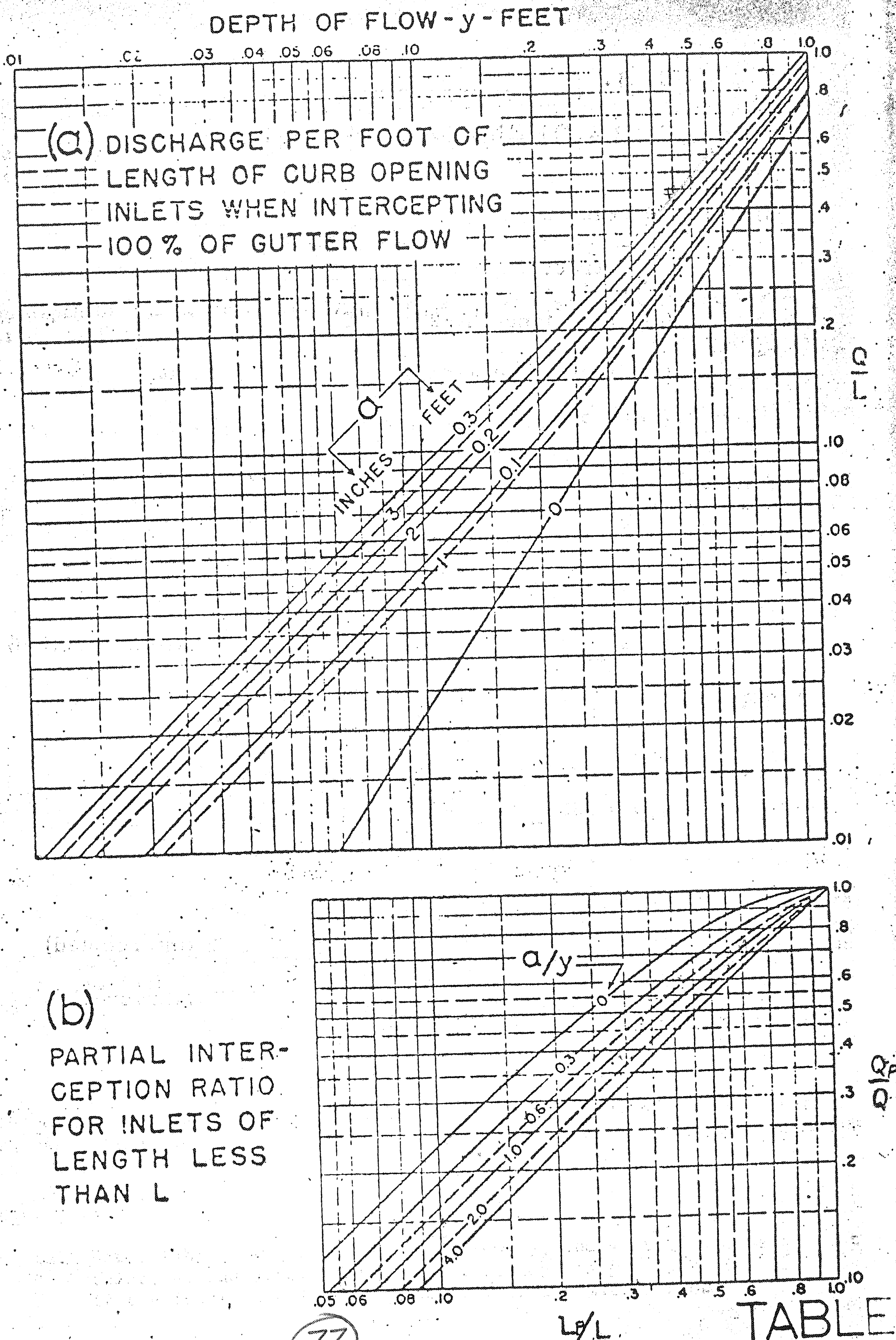
a/y = .33/____ = ☐

Q_p/Q = ____

Q_p= ____ X ____ = ____ CFS (Intercepted)

Q_c= ____ - ____ = ____ CFS (Carryover)

USE W= 14'



TABLE

BUREAU OF PUBLIC ROADS

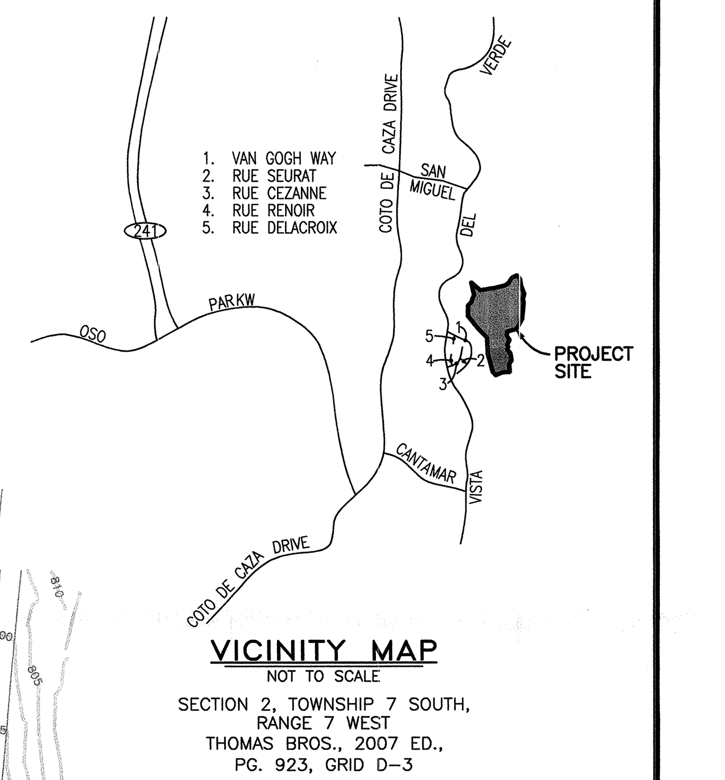
CAPACITY OF CURB OPENING INLETS ON CONTINUOUS GRADE

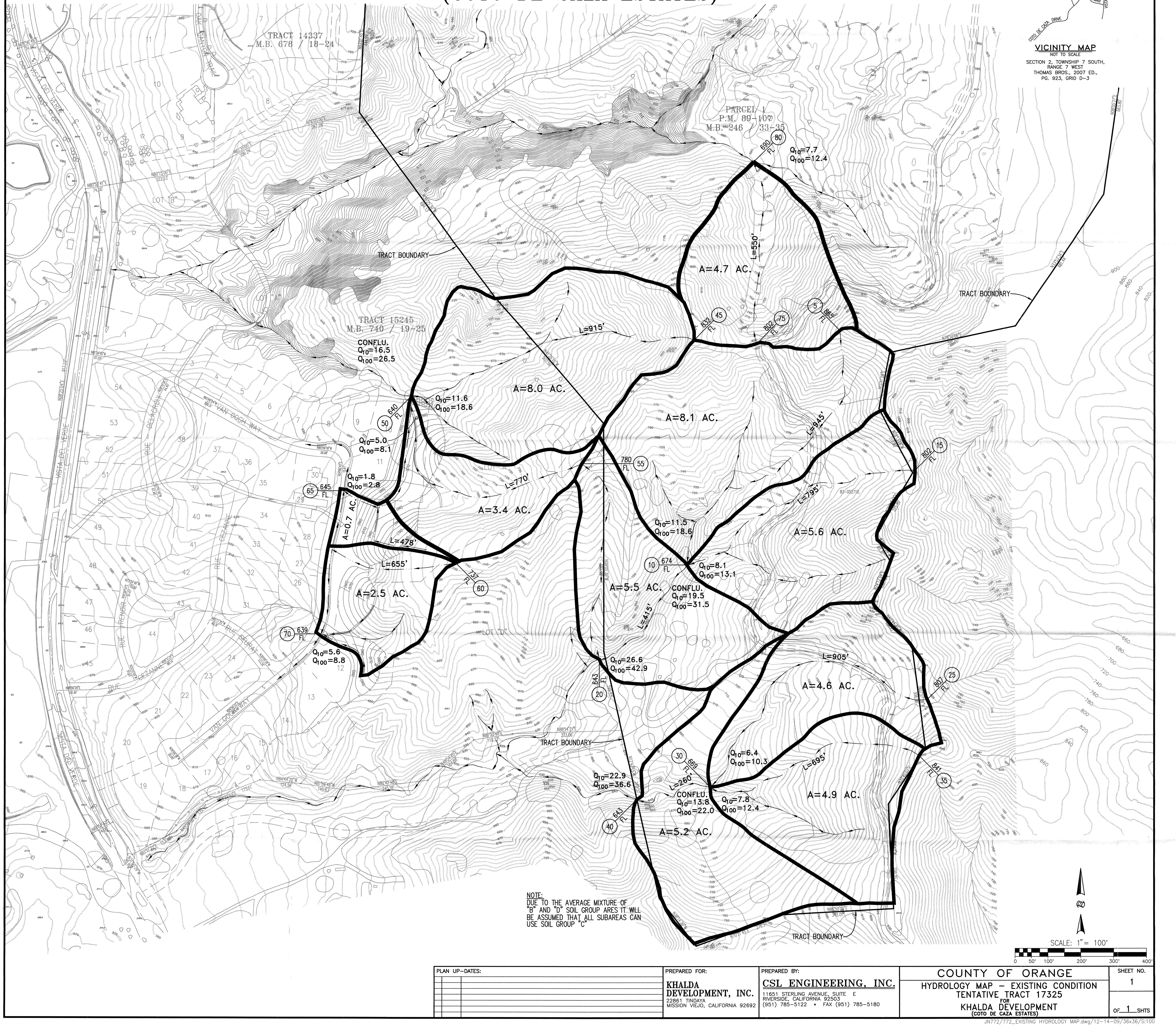
STREET CAPACITY SHEET

n=0.015 36' CURB TO CURB 2% CROSSFALL 6"CURB FACE

DEPTH	A	P	Q/S ½	
				HALF STREET
.16	.16	2.16	2.80	
.18	.21	3.18	3.40	
.20	.28	4.20	4.56	
.22	.37	5.22	6.28	
.24	.48	6.24	8.60	
.26	.61	7.26	11.59	
.28	.76	8.28	15.32	
.30	.93	9.30	19.85	
.32	1.12	10.32	25.24	
.34	1.33	11.34	31.57	
.36	1.56	12.36	38.89	
.38	1.81	13.38	47.25	
.40	2.08	14.40	56.73	
.42	2.37	15.42	67.37	
.44	2.68	16.44	79.23	
.46	3.01	17.46	92.37	
.48	3.36	18.48	106.83	
				HALF STREET
				FULL STREET
.50	7.44	37.00	252.98	
.52	8.18	39.00	286.07	
.54	8.96	41.00	322.05	
.56	9.78	43.00	361.01	
.58	10.64	45.00	403.05	
.60	11.54	47.00	448.27	
.62	12.48	49.00	496.77	
.64	13.46	51.00	548.64	
.66	14.48	53.00	603.98	
.68	15.54	55.00	662.88	
.70	16.64	57.00	725.44	

HYDROLOGY MAP FOR EXISTING CONDITION
TENTATIVE TRACT 17325
FOR
KHALDA DEVELOPMENT
(COTO DE CAZA ESTATES)

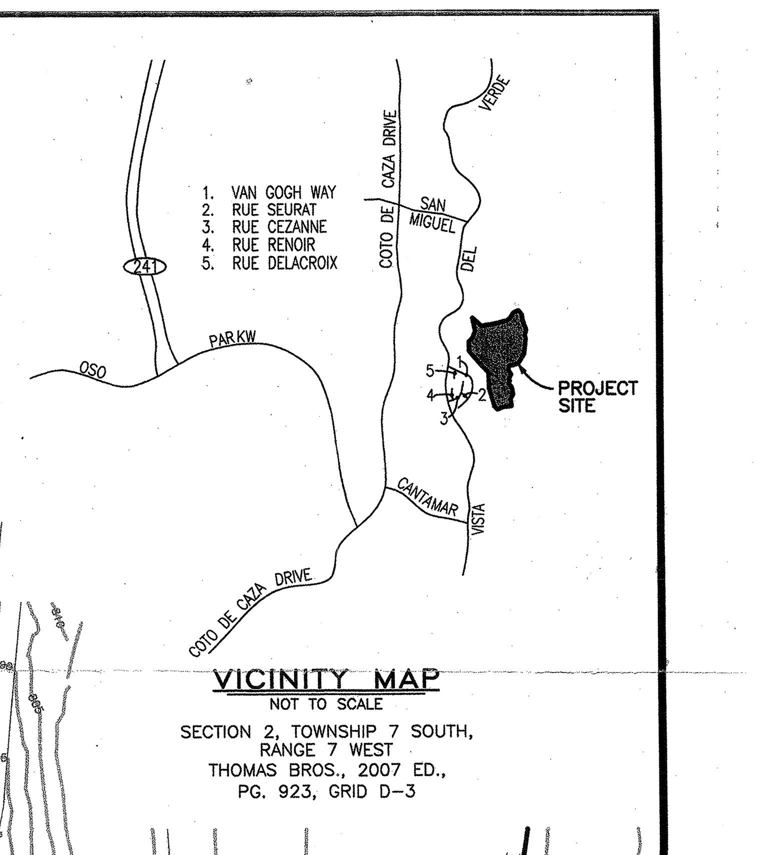


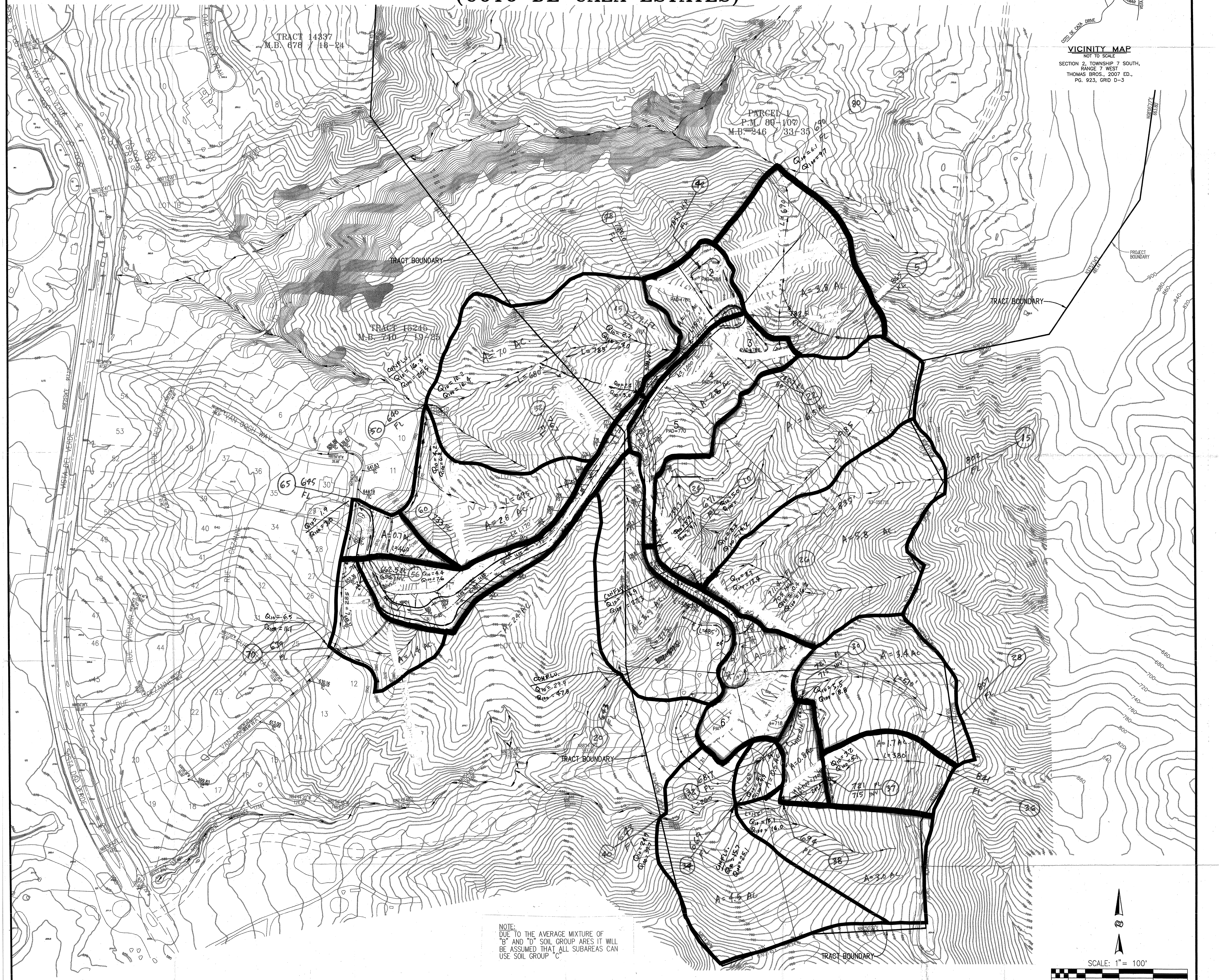


PLAN UP-DATES:	PREPARED FOR:	PREPARED BY:	COUNTY OF ORANGE	SHEET NO.
	KHALDA DEVELOPMENT, INC. 22861 TINDAYA MISSION VIEJO, CALIFORNIA 92692	CSL ENGINEERING, INC. 11651 STERLING AVENUE, SUITE E RIVERSIDE, CALIFORNIA 92503 (951) 785-5122 • FAX (951) 785-5180	HYDROLOGY MAP – EXISTING CONDITION TENTATIVE TRACT 17325 FOR KHALDA DEVELOPMENT (COTO DE CAZA ESTATES)	1 OF 1 SHTS

JN772/772_EXISTING HYDROLOGY MAP.dwg/12-14-09/36x36/S:100

HYDROLOGY MAP FOR DEVELOPED CONDITION
TENTATIVE TRACT 17325
FOR
KHALDA DEVELOPMENT
(COTO DE CAZA ESTATES)





NOTE:
DUE TO THE AVERAGE MIXTURE OF "B" AND "D" SOIL GROUP ARES IT WILL BE ASSUMED THAT ALL SUBAREAS CAN USE SOIL GROUP "C"

GENERAL NOTE:

1. THE BASE MAP USED FOR THE "HYDROLOGY MAP FOR THE DEVELOPED CONDITION" WAS BASED UPON THE PREVIOUSLY PREPARED LOT CONFIGURATION STUDY #4.

PLAN UP-DATES:

PREPARED FOR:
KHALDA DEVELOPMENT, INC.
22861 TINDAYA
MISSION VIEJO, CALIFORNIA 92692

PREPARED BY:
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COUNTY OF ORANGE
HYDROLOGY MAP – DEVELOPED CONDITION
TENTATIVE TRACT 17325
FOR
KHALDA DEVELOPMENT
(COTO DE CAZA ESTATES)

SHEET NO. 1 OF 1 SHTS

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